THE

QUARTERLY JOURNAL,

October, 1820.

Art. I.—*On the Inscription on the Column at Alexandria, in a Letter to the Editor, by the* Earl of Mountnorris.

Arley-Hall, June 21, 1820.

My dear Sir,

So much has been written respecting the inscription on the column at Alexandria, formerly called the Pillar of Pompey, that I think the accompanying drawing of the inscription made by Mr. Salt last year, and forwarded by him to me, will be interesting to many of your readers. The correctness of Mr. Salt's pencil is so well known that his drawing must put an end to all disputes as to the actual inscription on this celebrated column; but it may not be uninteresting to trace the progress made in ascertaining it; I have therefore sent you copies of the inscription as given by Pococke, Colonels Leake and Squire, and Dr. Clarke.

To Pococke is certainly due the merit of having first attempted to decipher this inscription; that he has in a great degree failed is excusable when it is considered under what difficulties every Christian then laboured who attempted to examine the antiquities of Egypt. Had he been able to dedicate more time to the work, he would have, probably, been more successful; as in one short visit he correctly ascertained the two first letters of the third line and the three first letters of the fourth line.

It is extraordinary that the French savans should not have made out any part of this inscription during their long residence at Alexandria, when they ought to have known that Pococke had read a part of it, and that other travellers had mentioned

its being legible. That they totally failed in doing so is evident from the concluding paragraph of the article on this column, by Monsieur Norry, given in the first volume of the *Mémoires sur l'Egypte*, who says, "On doit beaucoup regretter qu'une inscription qui étoit sur l'une des faces du piédestal ne soit plus lisible; on seroit éclairé sur ce monument, que les auteurs attribuent, les uns à la mémoire de Pompée, d'autres à celle de Septime Sévère."

An attempt was afterwards made to give to Monsieur Jaubert the credit of having made out the inscription, and to Monsieur Villoison of having first explained it; but there can be no doubt that the former obtained a copy of the inscription as taken by Messrs. Leake, Squire, and Hamilton, in 1802, and which had been widely circulated by them, and this is strongly corroborated by Monsieur Chateaubriand, who, in giving the inscription, says, "Je crois être le *premier* voyageur qui l'ait rapportée en France," and adds, "Le monde savant la doit à quelques officiers Anglais."

These officers were Colonels Leake and Squire, who, in September 1801, ascertained that the inscription was still in part legible. The deciphering of it was however delayed till the March following, by the absence of Colonel Leake, who accompanied Mr. Hamilton to Upper Egypt, but it was actively undertaken on their return, and the result was the ascertaining the whole of the inscription excepting three words.

In February 1803, Colonels Leake and Squire communicated their discovery to the Society of Antiquaries, and in their letter they give full credit to Mr. Hamilton as a fellow-labourer. An unsuccessful attempt has, however, since been made to deprive Messrs. Leake and Hamilton of all share in the thanks due to the discoverers by the literary world. Two letters have been published by Dr. Clarke, written by Colonel Squire to his brother, and from which the doctor infers that "all idea of attempting the discovery is due to Colonel Squire, and that he had the greatest share in its execution*."

* Clarke's *Travels*, Sec. II. Part II. page 257.

The first letter, as given by Dr. Clarke, is without a date, but evidently written later than February 1803; it is as follows: "I believe the paper presented to the Antiquary Society, contains the best history of the discovery of the Alexandrian inscription. I wish not to be brought forward in any literary dispute, but the fact is, that most of the letters were discovered by me while Messrs. Hamilton and Leake were in Upper Egypt. I had seen the *same* inscription in Pococke's Travels before I knew of its existence from that book." The second letter is dated Alexandria, Christmas-day, 1801. "Here let me remark that it is not *impossible* but that part of the inscription on the great pillar may yet be read. Π and O are legible enough, and by other remains of characters, I can plainly perceive that the inscription consisted of four lines in Greek. With sulphur, an impression of these characters might be taken, and *perhaps* something satisfactory discovered. Before we quit the country, I will certainly endeavour to make the experiment *."

The conclusions drawn from these letters by Dr. Clarke, imply that Messrs. Leake and Hamilton have assumed to themselves a share in a discovery to which they had no right: this is a very serious charge, and which does not appear to me to be sustained by the letters themselves, even admitting the statements in them to be perfectly correct. Colonel Squire does indeed claim for himself the having discovered most of the letters during the absence of Messrs. Leake and Hamilton, in Upper Egypt; but this could not be called a discovery, for the same had long before been done by Pococke, and nothing can be more different than the ascertaining that detached letters are distinguishable, and the deciphering a sufficiency of the inscription to show its sense, and to whom the column was dedicated. Indeed, the only two letters Colonel Squire claims as having made out, were Π and O, and these had already been given by Pococke, who had also given the following or third letter;

* On this Dr. Clarke observes, "that even the device of the sulphur was due to him." There was but little merit in this device; it was tried, and a third part of the inscription was taken off; but without the discovery of a single additional letter. It was, in fact, totally useless.

so that in fact, on the arrival of Messrs. Leake and Hamilton at Alexandria, in March 1802, Colonel Squire had *less* knowledge of the inscription than he might have obtained from Pococke, whose work he, probably, had not with him. The expressions used by him in his letter of Christmas-day 1801, when Messrs. Leake and Hamilton had been absent three months, show clearly how little had then been done. He then considered it "as *not impossible* that part of the inscription *might* be read, and that, *perhaps*, something satisfactory might be discovered;" and he had then "determined to endeavour to make the experiment." That he did any thing in the following two months of January and February is no where asserted by him, but, on the contrary, he declares in the letter published under his signature and that of Colonel Leake, that the first discovery of any *word* was made in March 1802, and in the same letter he admits that Messrs. Leake and Hamilton had an equal share in the meritorious and successful endeavour to decipher the inscription.

I should have been sorry that so respectable an officer as Colonel Squire should have asserted any thing in a private letter which was at variance with what he had published under his hand, but this he has not done. He has not claimed for himself the first idea of deciphering the inscription, or that he had the greatest share in the execution. Had he done so, I should still have given credit to the positive assertions of Messrs. Leake * and Hamilton †, that they had a full share in deciphering the inscription. I cannot therefore agree with Dr. Clarke "that all the information afforded by the inscription would have been consigned to everlasting oblivion but for the

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* *Classical Journal*, No. XXV., page 152, and No. XXIX., page 161.

† *Ægyptiaca*, page 403. In this place Mr. Hamilton expressly asserts that he was a fellow-labourer in the deciphering of the inscription, and adds that, "after visiting it for several days successively at the most favourable hour, when the rays of the sun first struck obliquely on the plane of the letters, we obtained the following lines:" This passage Dr. Clarke has quoted as his authority for asserting "that Mr. Hamilton arrived in Alexandria, as it *has been related by him, after the inscription had been found, and the undertaking for copying it had been begun.*"

important discovery made by the late Lieutenant-Colonel Squire, of some remaining characters upon the pedestal, while Mr. Hamilton, and his companion Major Leake, were in Upper Egypt." On the contrary, I believe that if these gentlemen had never returned to Alexandria, Colonel Squire would have done as little after March 1802, as he had done in the six months preceding.

During my residence at Alexandria, in the spring of 1806, Mr. Salt dedicated many days to the deciphering and drawing of the inscription. This drawing was unfortunately lost after my return to England, but from memory I was enabled to state * that the pillar was unquestionably dedicated to Diocletian, and that the three first letters of the name of the prefect were ΠΟC, as had been originally stated by Pococke. On the appointment of Mr. Salt to fill the station of His Britannic Majesty's Consul-General in Egypt, I most particularly requested him to re-copy the inscription. I have now the pleasure of forwarding to you the result of his labour, by which are ascertained the three words left undeciphered by Messrs. Leake, Squire, and Hamilton, *viz.*, ΤΙΜΙΩΤΑΤΟΝ ΑΝΙΚΗΤΟΝ, and the name of the Prefect ΠΟCΙΔΙOC.

Colonel Leake conjectured the first word to be ΤΙΜΙΩΤΑΤΟΝ, and the deciphering of the ΜΙ before the Ω has proved it to b so. Jaubert had asserted it was ΟCΙΩΤΑΤΟΝ. Chateaubriand had suggested CΟΦΩΤΑΤΟΝ.

The second word had been ascertained by Mr. Salt in 1806, and it had been communicated to Colonel Leake and others, yet many years afterwards Chateaubriand had recommended ΑΥΓΟΥCΤΟΝ; and Dr. Clarke, CΕΒΑCΤΟΝ. The second investigation of Mr. Salt has confirmed his first.

The third word may be considered as the most important, as it ascertains the name of the Prefect who dedicated the pillar to be ΠΟCΙΔΙOC, and not ΠΟΜΠΗΙOC, as conjectured by Dr. Raine; ΠΟCΤΟΜΟC, as conjectured by Dr. Clarke; or ΠΟΛΛΙΩΝ, as conjectured by Chateaubriand.

Dr. Clarke has attempted to establish, that the beginning of

* Valentia's *Travels*, Vol. III. page 464.—London, 1809.

the third line of the inscription ought to be read **ΔΙΟΝΑΔΡΙΑΝΟΝ**; but, as he admits that he did not decipher a single letter of the inscription, his conjecture cannot be placed against the positive testimony of Messrs. Leake, Squire, and Hamilton, who first ascertained the name to be **ΔΙΟΚΛΗΤΙΑΝΟΝ**; and of Messrs. Jaubert, Salt, and Chateaubriand, who equally assert that they distinguished clearly this name, to which, if necessary, I could also myself testify.

No doubt can now remain that the inscription must be read as follows:

ΤΟΝ ΤΙΜΙΩΤΑΤΟΝ ΑΥΤΟΚΡΑΤΟΡΑ
ΤΟΝ ΠΟΛΙΟΥΧΟΝ ΑΛΕΞΑΝΔΡΕΙΑC
ΔΙΟΚΛΗΤΙΑΝΟΝ ΤΟΝ ΑΝΙΚΗΤΟΝ
ΠΟCΙΔΙΟC ΕΠΑΡΧΟC ΑΙΓΥΠΤΟΥ

["Posidius, prefect of Egypt (has erected) the most honoured emperor, the guardian deity of Alexandria, Diocletian the Invincible."]

I do not mean to assert that there was no fifth line, but I certainly could not distinguish any vestiges of it; and Mr. Salt's drawing shows that, on his second examination, he was of the same opinion.

I cannot but wish that the name of the Prefect had been Pompey, as it would have accounted for the name by which this celebrated pillar has been latterly called. Sandys says, that "it was called by the Arabians Hemadeslaer, but by the Western Christians the Pillar of Pompey." With these foreigners, therefore, the modern name originated, and not with the natives. Tradition could have no weight against positive testimony, were there any to support its former name. It is now proved that the column was dedicated to Diocletian, and it will, probably, in future, be called by his name.

Believe me to be,
My dear Sir,
Yours, ever faithfully,
MOUNTNORRIS.

To
W. T. Brande, Esq.
Royal Institution.

The inscription on the column at Alexandria, copied by Pococke :—

⅃Ↄ .. 7....ΟCΟΤΑΤΟΙΡ . Ο . Ρ . ΤΛ
ΤCC..ΟCΟΝΙΟΥ.. ΤΟΝΛΛΕΛΛΔ
ΔΙC ΜΑΡΡΟΛΠΟΝΤΟΝΛΛΙ..
ΠΟCΕ.....ΛΡΛCC.....

The inscription as given by Dr. Clarke :—

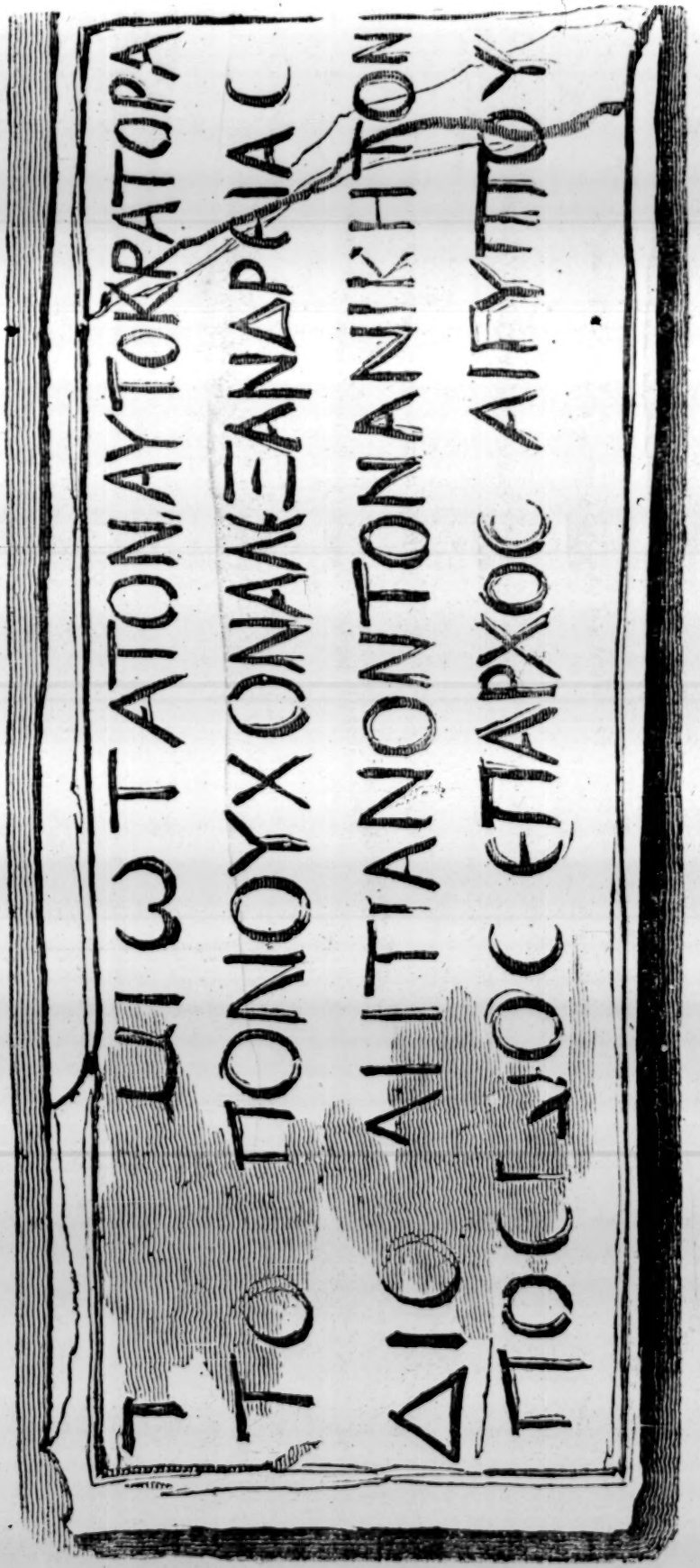
ΤΟ.....ωΤΑΤΟΝΑΥΤΟΚΡΑΤΟΡΑ
ΤΟΝΠΟΛΙΟΥΧΟΝΑΛΕΞΑΝΔΡΕΙΑC
ΔΙΟ.....ΙΑΝΟΝΤΟΝ.....ΤΟΝ
ΠΟ.....ΕΠΑΡΧΟCΑΙΓΥΠΤΟΥ

The inscription as copied by Colonel Leake, Colonel Squire, and Mr. Hamilton :—

ΤΟΝ ωΤΑΤΟΝΑΥΤΟΚΡΑΤΟΡΑ
ΤΟΝΠΟΛΙΟΥΧΟΝΑΛΕΞΑΝΔΡΕΙΑC
ΔΙΟΚΛΗΤΙΑΝΟΝΤΟΝΑ....ΤΟΝ
ΠΟ.....ΕΠΑΡΧΟCΑΙΓΥΠΤΟΥ

The inscription as copied by Mr. Salt :—

Τ ΜΙωΤΑΤΟΝΑΥΤΟΚΡΑΤΟΡΑ
ΤΟ ΠΟΛΙΟΥΧΟΝΑΛΕΞΑΝΔΡΕΙΑC
ΔΙΟ ΛΗΤΙΑΝΟΝΤΟΝΑΝΙΚΗΤΟΝ
ΠΟCΙΔΙΟCΕΠΑΡΧΟCΑΙΓΥΠΤΟΥ


ΔΙΟΚΛΗΤΙΑΝΟΝΤΟΝΑΝΙΚΗΤΟΝ
ΠΟΛΙΟΥΧΟΝΑΛΕΞΑΝΔΡΕΙΑΣ
ΤΟΝ ΑΥΤΟΚΡΑΤΟΡΑ
ΠΟΣΙΝΟΣ ΕΠΑΡΧΟΣ ΑΙΓΥΠΤΟΥ

Art. II.—*On the apparent Changes of Place, Colour, Size, and Figure of the Heavenly Bodies.—By* G. W. Jordan, Esq., A.M. F.R.S.

All the celestial luminaries are observed to be subjected to apparent changes of place, beginning at points below the zenith, where no change is, and increasing at stations descending towards the horizon. Of the sun and moon at considerable elevations, the light is more or less white, but at lower altitudes, these luminaries become tinged with dilute tawny colours, and the sun, when so low that it may be viewed with the naked eye, becomes of a brilliant yellow, which changes to a brilliant red, of decaying brightness until the orb sinks below the horizon. At equal altitudes, the moon exhibits similar but fainter colours. As the sun declines, not only these changes occur of place, of colour, and of quantity of light, but the disc itself also undergoes considerable apparent changes, primarily of dimensions, and subsequently of figure. Primarily a general enlargement of disc appears, subsequently a contraction of vertical diameter, accompanied with a more considerable extension of horizontal diameter, and a change of upper and lower limbs from circles to ellipses, the lower being considerably more eccentric than the upper. In this state of approach to the horizon, the lower limb occasionally suffers considerable fluctuations, and variations of outline, contracting and enlarging in different points at the same time.

These changes of place, colour, brightness, dimensions, and figure, have been variously accounted for. As they occur at the same stations, and under the same circumstances, they are unquestionably to be referred to the same causes. Each however has been considered apart from the other, with other views than that of ascertaining the true causes of each, or of all. The change of place has been considered by astronomers with a view to ascertain its amount at a given station, and from this to estimate its variation and amount at other stations.

The change of dimensions and of figure, particularly on the verge of the horizon, has exercised the ingenuity of the greatest philosophers, and still remains *vexata questio.* The change of colours has only been occasionally remarked upon. All these changes will however be found concurrent and illustrative of each other; whilst the various attempts to account for them singly, exhibit such a misapplication of principles, and want of information respecting the ordinary phenomena of light, as will only surprise him who knows not how little is at present generally and correctly understood of light, in its causes and principles of existence.

Astronomers, who first noticed the changes of place in the heavenly bodies, have variously attempted to account for their existence, and to estimate their amount. They consider the atmosphere as consisting of innumerable concentric laminæ, of various densities, and of refractive powers increasing in the approach to the surface of the earth,—that the rays of light, in passing thruogh the atmosphere thus constituted, are subjected to refractions, such as occur at the confines of different refractive media, by which they are similarly bent, in various directions towards the perpendiculars to these laminæ, and that changes and elevations of the apparent places of objects are in this manner produced. At the confines of different adjacent refractive media, there is always a division of the light into two portions reflected and refracted, each of them containing a given portion of the incident light. By calculations founded upon the continuance of twilight, after the sun has sunk below the horizon, it has been estimated that at the distance of from 40 to 75 miles from the surface of the earth, there are powers in the atmosphere, capable of producing the twilight; and at these elevations, these concentric laminæ are referred to, as reflecting from their supposed lower surfaces, light adequate to the effect produced.

This estimate, however, of the height of the atmosphere on which twilight depends, is in itself incorrect, as being founded on the false principle that it depends on single reflections at the preceding altitudes of the light of the sun sunk below the

horizon, whereas it is produced by many and repeated reflections of the vapours floating in the atmosphere, and at last reaches the eye of the spectator by a course so indirect, as to leave no power of estimating the distances from the earth of the reflecting particles.

Of these floating particles, upon which twilight and other atmospheric phænomena depend, the altitudes thus assumed exceed all reasonable estimate. A' observations respecting the constitution of the air, show twilight to be the product of the whole atmosphere, and its contents near the surface of the earth. The tops of the highest mountains, five miles above the level of the sea, are scarcely attained and surmounted by any vapours, by any reflecting particles, capable of producing sensible effects from their sizes or numbers. The supposed height of the atmosphere capable of reflecting the height of twilight, being 50 miles according to Keill, whose estimate is a mean between others, the lengths of air traversed by light in the horizon is 12 times greater than in the zenith. (*Vide Keill's Astronomy*, p. 244.) This gives the enormous tract of 600 miles for the passage of the horizontal light of the luminaries. Through an atmosphere of 75 miles, 50 miles, or 40 miles height, divided into various reflecting and refracting laminæ, as alleged, not the light of twilight, not the light of the meridian sun would reach the surface.

Euler supposed a single bending of the rays at the confines of æther and atmospheric air, such as occurs between any other two transparent refractive media. This hypothesis escapes the preceding objection, but is subjected to the difficulties of an hypothesis which would establish confines between air and æther, similar to those between other transparent media of different refractive powers, together with all the other objections to atmospheric refractions.

The atmosphere is not a laminated but a continuous body.

In the passage of light through a transparent continuous medium, there is neither reflection nor refraction by the medium; and therefore there are in fact no atmospheric refrac-

tions, and some other mode of accounting for the phænomena must be resorted to.

The atmosphere is a transparent continuous body: nor will the division into ideal laminæ, by imagining surfaces, produce effects which depend upon a distinct separation of parts, into distinct surfaces, severally belonging to the several media at their confines. Of transparent continuous bodies, the reflections and refractions are only made at their confines, where they are adjacent to other transparent continuous bodies of different refractive powers, at which confines exists that state of discontinuity and distance, upon which their reflections and refractions depend.

The difference of refractive powers of any two adjacent portions of the atmosphere, if any difference can be supposed, if any formation of laminæ can be admitted, if any state, similar to that of the confines of two different media of different refractive powers, can be imagined to exist, at every mental or ideal division of the continuous fluid of air—the difference, it may be observed, of the refractive powers of these portions of the air where they join, cannot but be less than that of crown glass and flint glass. The solid bodies of crown glass and flint glass, pressed together by powers considerably less than the ordinary weights of the atmosphere, may be made so closely to approach together, that all reflection and refraction will be extinguished at their confines, and light pass through both, as uninterruptedly as through one continuous body. The parts of the air are of one continuous body, and if they were not, are yet so powerfully pressed together that they would be, for the passage of light, as parts of one continuous body.

When a portion of light, in a continuous transparent medium, passes by the side or edge of any other body in that medium, it is inflected or bent towards that body, in angles proportioned to the distances of the parts of the light from the side or edge. These bendings have been observed by philosophers, and by them named inflections. The principal phænomena of inflections, more than thirty years ago, I observed and explained,

correcting some very important errors of great authority, disposing of the supposed anomaly of the repulsion of light by bodies, and of that repulsion being changed at other distances into attraction, by pointing out the bodies whose attractions had been mistaken for the repulsions of other bodies, and thus referring all the appearances to the single and simple principle of attraction. These inflections exist in the same continuous medium, refractions never but at the discontinued confines of different media. These inflections, in the continuous medium of air, produce all the preceding observed changes of the heavenly bodies.

In imperfectly transparent media, as opals, rubies, coloured glasses and tinctures, various particles are diffused throughout the bodies, which by their inflections change the directions and colours of the light at varying thicknesses. Such a continuous medium is the atmosphere; transparent in itself, imperfectly transparent in consequence of the floatage of various particles of other bodies throughout and between its parts.

At the confines of any two adjacent transparent bodies, there is a discontinuity, and separation to definite intervals, of the particles of both, dependent upon the relative attractions of the particles of each body, for themselves, and for the particles of the other body; which attractions, although they prevent such an intimate union of the bodies as would end the reflective and refractive powers of both, does not altogether cease to exist between the neighbouring particles of each for the other; and there is one class of transparent continuous bodies, between whose particles there exist in given lines of direction, intervals of aggregation similar to the intervals between different media, which although the bodies cease not to be continuous aggregates, yet, at these intervals, a division of the light takes place, similar to that between different transparent bodies, and produces a double refraction within the bodies, in lines duly related to these and other lines of aggregation. This original conjecture respecting the causes of the double refractions of certain crystals, was happily confirmed by the splendid discoveries of Malus, who observed that a polarization also takes

place in the light divided at the confines of different transparent bodies, similar to that produced in the light divided within doubly refracting crystals. Thus from similarity of effects is established the suggested similarity of causes in both, of causes existent, and derived from the phænomena.

These supposed causes of the changes of place in the heavenly bodies being thus disposed of, the modes of estimating or calculating their amount may be next considered. Together with these unsupported hypotheses of causes, may at the same time be disposed of, all methods of calculation founded exclusively on the existence and operation of these causes.

Professor Vince, in his *Complete System of Astronomy*, has detailed at large the principles adopted to account for these apparent changes of place, and the different methods invented for estimating their amount, and that of the occasional variations observed in these changes themselves.

" When a ray of light passes out of a *vacuum* into any *medium*, or out of any medium into *one* of *greater density*, it is found to deviate from its rectilinear course towards a perpendicular to the surface of the medium into which it enters. Hence light passing out of a vacuum into the atmosphere will, where it enters, be bent towards a radius drawn to the earth's centre, the top of the atmosphere being supposed to be spherical and concentric with the centre of the earth; and as in approaching the earth's surface, the density of the atmosphere continually increases, the rays of light as they descend are constantly entering into a denser medium, and therefore the course of the rays will continually deviate from a right line and describe a curve; hence at the surface of the earth the rays of light enter the eye of the spectator in a different direction from what they would have entered, if there had been no atmosphere; consequently, the apparent place of the body from which the light comes must be different from the true place. Also the refracted ray must move in a plane perpendicular to the surface of the earth; for conceiving a ray to come in that plane before it is refracted, then the attraction being always

towards the perpendicular which lies in that plane, the ray must continue to move in that plane. Hence the refraction is always in a vertical circle."

These are the accepted doctrines of the day, and delivered as such by the Professor.

According to these statements, " when the light passes (obliquely it should have been stated), out of any medium into one of greater density, it is found to deviate." To produce this deviation however, the circumstances stated are not sufficient. The light must pass not only out of " any medium into one of greater density," but out of one medium *into another—into another and not the same*—not the same even *increased in density* —into another *distinct and separate* medium, not merely of *greater density* but of *greater refractive power.* Refractive power is not identical with density. The refractive power of glass for instance, is to that of water as 55 to 34, its density as 87 to 34. Change of density alone, and not of medium, and of refractive power will not produce the reflection, refraction, dispersion, or change of direction of light. Thus the principles assumed to account for the apparent changes of place in the heavenly bodies fail, together with all the observations dependent upon and connected with them.

A ray of light always moves after refraction in the plane of incidence, whether it falls on a plane or curved surface. That refracted rays therefore may move in vertical circles only, they must come in vertical planes only. But rays of light do not necessarily move either before or after their supposed refractions in vertical planes, and their bendings therefore are not always necessarily in vertical circles. If this were the case, no changes of the diameters, parallel to the horizon, of sun or moon could ever take place, and all measurements thereof to discover any, would be useless. It is however to be conjectured and feared, that this opinion, of the supposed refractions necessarily being in vertical circles, has influenced observation, has led to erroneous conclusions respecting the phænomena, and affecting even the judgment of observers in their measurements and estimates, has contributed to establish and continue error.

Such are the defects of the doctrines of the astronomical schools on this subject. They are not to be imputed to the Plumian professor, but belong to the system, which he delivers as received. His esteemed work was among my books, and in seeking to give an account of atmospheric refractions, as they are called, my opinion of him led me to that. I should have found the same things in any and every treatise of astronomy to which I could have referred.

The different methods of ascertaining the amount of these changes of place, determining it for one altitude and object by direct observation, and estimating it for other altitudes, objects, and places, do honour to the talents of astronomers in every age. Tycho, Cassini, De la Caille, Newton, Bradley, Hawksbee, Maskelyne, and others, calculated, but possessed no correct conceptions of the causes of the phænomena.

These changes of place having been found to vary in themselves, not only at different altitudes of the luminaries, but at the same elevations also, in different states of the atmosphere, and changes in the barometer and thermometer having been observed to be cotemporaneous with those; these, although themselves depended upon other changes, have been considered as connected with and influencing those, and have been taken into the account in which those were estimated and calculated. There are, however, conditions and changes of the atmosphere, dependent upon other causes than its temperature and weight, which are indicated by the hygrometer, and upon which the phænomena themselves more immediately depend. These, therefore, rather than those, or perhaps together with those, are to be considered; and thus it appears how uncertain all knowledge is, not founded upon a knowledge of causes. *Rectè scire est per causas scire.*—Bacon.

The apparent changes of place in the luminaries, in their lowest stations near the horizon, are indeed subjected to anomalies, which render confessedly, the calculations applied to the higher, not to be depended upon in these last stations.

Whether in calculations, which require these apparent variations of change of place to be taken into the account, and

therefore to be correctly determined, any estimate can or ought to be depended upon, except derived from observations made at the time, and upon the occasion, during the existing state of the atmosphere, and independently of the principal observations, will hereafter appear. Many modes of making these observations will occur to practical astronomers, to whom we defer with all due respect in matters purely astronomical.

The apparent and extraordinary changes of dimensions, and of figure, in the sun and moon in stations just above the horizon, have been referred by various conjectures to various causes.

Des Cartes, Wallis, and others, suppose that a better judgment being formed of the distance of the moon by comparison with objects in the horizon, she is considered as more remote, and therefore appears larger in the horizon than in the zenith.

Ptolemy, considered the effect, as in part a fancied, in part an actual enlargement of apparent disc, and conformably to this latter opinion Roger Bacon ascribes the enlargement to refraction. Gassendus ascribes the appearances to an increased dilatation and flatness of the pupil of the eye in less light producing a larger picture on the retina; Berkeley to the diminished horizontal light of the moon; Smith to the apparent figure of the sky as being less than an hemisphere, the moon retaining her size unchanged, and appearing, upon the principles of perspective, larger at supposed remoter distances.

The horizontal diameters of sun and moon have been subjected to actual measurements with varying conclusions. Riccioli affirms, that together with Grimaldo, having, with a sextant, carefully and repeatedly measured the horizontal diameter of the sun, one by the right, the other by the left limb, they distinctly ascertained the increase to be what the naked eye exhibits. Almost all other philosophers have considered the appearances to be delusive, to be optical deceptions, and have affirmed that measurements by instruments give no increase of dimensions. Almost all are of opinion that the refractions, which, as they suppose, produce these appearances, can only be in vertical circles.

Riccioli and Grimaldo state, the observed diameter of the sun in the horizon to be from 45 to 60 minutes, of the moon from 38 to 40 minutes.

Molyneux objects that the moon ought to have appeared under an angle of 5 degrees. Did any person ever see the moon extended under an angle of 5 degrees in the horizon ten times larger than usual? This argument then fails in fact, as does also the other, that there is no refraction or change of place but the vertical, and therefore no dilatation.

I agree with Riccioli and Grimaldo; because their measurements accord with the theory hereafter to be developed; because they agree in their amount with the appearances, vertical as well as horizontal; and because of their very differences; for of the sun and moon, the mean apparent diameters are nearly equal, and severally about 32′ and 31′, and according to their observations, the measured diameters are from 45′ to 60′ of the sun in the horizon, from 38′ to 40′ of the moon, the weaker marginal light of the moon being extinguished, and her size more reduced by the atmosphere through which she appears, than that of the sun.

The size of a candle, viewed through different deeply-coloured glasses, is considerably diminished by the loss of its fainter marginal light; and so the sun and moon ought, on account of the loss of light in passing through the atmosphere, to appear, and would appear, diminished in diameter, but that this cause of diminution is more than compensated for, and the discs are more enlarged by, the lateral inflection of the rays than diminished by the extinction of the marginal light. By the increased extinction, however, of the weaker marginal light of the moon, her apparent size is more reduced than that of the brighter and more strongly illuminated sun, the atmosphere, through which they both are seen, acting as a coloured glass, giving colours to both luminaries in different degrees and producing these differences in the measurements of Riccioli and Grimaldo.

Thus the theory to be hereafter developed, confirms the observations of Riccioli and Grimaldo made, particularly upon

the horizontal diameter of the sun, and established so distinctly by the plain perceptions of sense, that nothing but that ingenious learning, which in every age has puzzled the plainest things, could have induced a doubt respecting what was actually seen, although the cause was not understood.

Riccioli accounts for the differences of opinion and measurement of others, by supposing that, by the adopted modes of measurement, which he states, differing from his, the external light of the limb of the object is intercepted, and its size reduced.

I have endeavoured variously to account for these continued errors of the acutest observers, by supposing that taking it for granted that all changes of place, or refractions, as they called them, were made in vertical circles, which is not correct, and that all measurement of any but the vertical diameter of the luminaries was unnecessary, upon finding this to be what was expected, they abandoned all further observations of horizontal diameters, not perhaps so conveniently measured as in the vertical line, or made them without sufficient care and attention.

The rainbow has been referred to, as exhibiting near the horizon, a considerable increase of breadth, upon the same principles which produce the apparent enlargement of the horizontal sun and moon, and thus confirming them. But one error is here adduced to support another. The cases are entirely different. The rainbow is seen under very different circumstances, and at short distances, which allow neither the imagination to act nor the atmosphere. Of the falling drops of rain, the increased sizes near the horizon, extend the spaces of formation of the radiants which they reflect, increase their number and divergence, and thus enlarge the dimensions of the bow which they form. I have seen the primary rainbow completely formed, and at the same time the following appearances exhibited: In the thin vapour of the cloud on high, was formed a narrow principal bow, attended with three or four inflected orders of colours, which are known to depend upon the small sizes of the drops. By degrees, lower down, these accompanying bows disappeared by uniting into the single primary, whose dimensions in the horizon became dilated into more than double

its original breadth, in consequence of the increased sizes of the united drops.

The changes of colour, and of brightness, have not been attentively considered, or happily explained in themselves, or as connected with the other changes of place or of figure. The attempts to account for these are not more philosophical than those of the poet:—

> Ipse Dei clypeus, terrâ cum tollitur imâ
> Mane rubet, terrâque rubet cum conditur imâ.
> Candidus in summo est; melior natura quod illic
> Ætheris est, terraque procul contagia vitat.
>
> Ov. *Metamor.* lib. 15. l. 192—5.

In a continuous medium, a ray of light, passing by the side or edge of any body contained therein, is inflected by the attraction of the body near which it passes, and bent towards it.

In such a medium a ray of light passing between two bodies, is inflected and bent by the difference of the forces of the two bodies, towards that body nearest to which it passes, and whose attraction consequently prevails.

A ray of light so passing, is not only so bent and inflected, but is also dispersed and divided into parts more or less bent in various directions towards the inflecting body, the colours of its several parts being changed, from that of the original light, into rays of what are called prismatic colours, which coloured rays, even in the refractions of the prism, are produced by inflections. the blue being nearest to, and most attracted by, the inflecting points, the red most remote from and lest bent towards them, the intermediate, in and into intermediate directions.

A ray of light, passing perpendicularly through a series of particles concentrically arranged in the plane of incidence, and at equal distances between the particles, passes on without deviation or bending.

A ray of light, passing obliquely through a series of particles concentrically arranged in the plane of incidence, will be inflected and bent, in a direction inclined towards the radius drawn from the centre of arrangement to the point of passage.

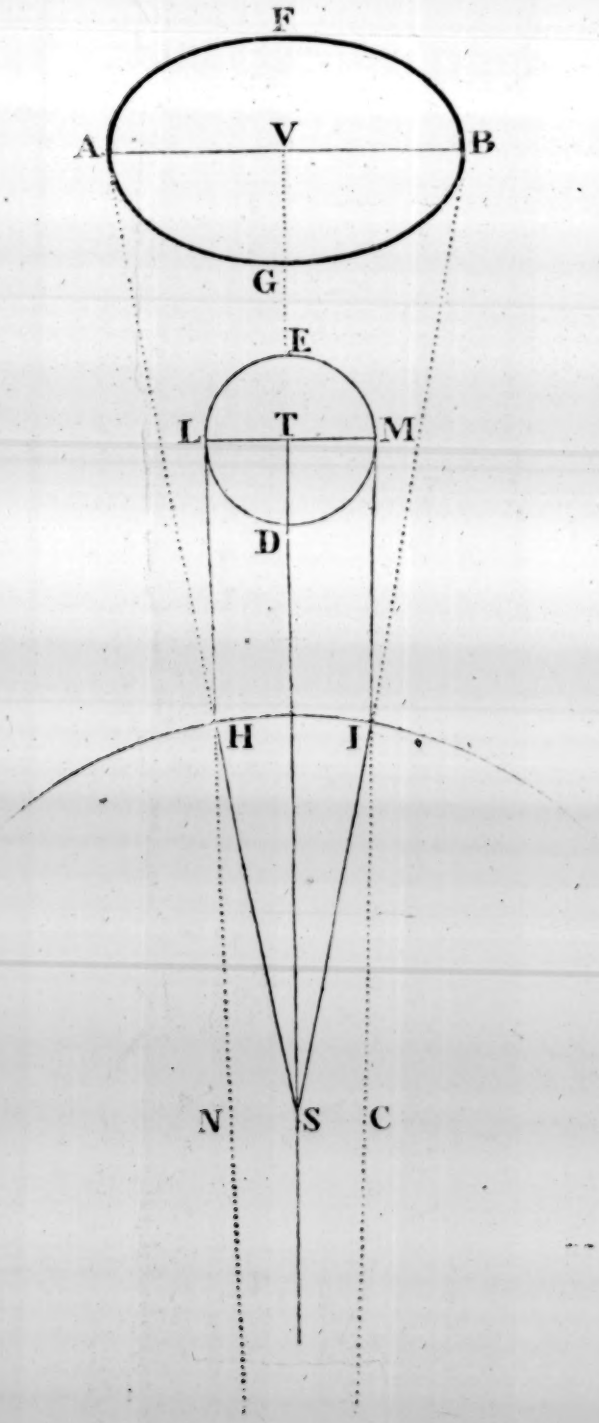
A ray of light, passing perpendicularly, at equal distances, between the particles of each series, and successively through many series of particles, concentrically, and more and more numerously arranged in different successive planes, will be attracted by, and inflected towards the planes, in which the greater number of particles are disposed.

A ray of light passing obliquely and successively, through and between various concentric series of particles in various planes, and of variously increasing numbers in those planes, will be inflected and bent, into directions compounded of the directions given by the succeeding different planes and concentric series, conformably to the established laws of motion.

The body of air, incumbent upon the earth and its waters, acting by its powers of solution becomes more or less charged, more numerously at small, less numerously at greater distances from the surface, with particles of water floating in it, in states intermediate between absolute solution and rapid precipitation. These particles in a further state of separation from, and floatage in the air, are congregated into visible forms, and become fogs and clouds. In the intermediate state between perfect solution and visible separation, though they do not entirely destroy the transparency of the atmosphere, they yet exist in the air as floating detached bodies, capable of acting upon light by reflecting and inflecting it, and show their existence and powers frequently, by exhibiting the tracts of the sun-beams passing from between clouds through the air, or by otherwise variously acting upon objects seen through the vapours which they compose.

By the observation of those who ascended Mont Blanc, and were terrified at the black apparent void beyond the top, there were then no particles in the air, higher than the mountain, capable of reflecting light. Mont Blanc is not quite three miles above the level of the sea. Seldom higher than this, above the level of the surrounding region, can the vapours of flat countries be considered to rise, so at least as to become sensible by their actions on light, and to this height must be reduced the great concentric masses of sensible vapours supposed to be from fifty

to seventy miles high. The principal accumulations of vapours, are indeed considerably short of this height, and being upon or near the surface, their strata may in effect be considered as of various horizontal diameters from 12, to 24, to 30, miles long, as they may be estimated to be of the height of one, two, or three miles.



Let S, be the place of a spectator, ED the sun, LM a line drawn through the centre of the sun parallel to the horizon, TS a line drawn from the centre of the sun to the spectator, HI a circular series of particles of vapour arranged at given distances from each other in the same plane with LM, and TS, and cutting TS at right angles, a ray of light from T passing along TS, through the circular series HI, at right angles and at equal distances between any two particles will proceed directly without bending to the eye of the spectator. Let LH and MI from the points L, and M in the line LTM, be rays parallel to and in the same plane with TS. As TS falls perpendicularly on HI, so LH and MI will fall obliquely on HI, and instead of passing on to N, and C will be bent at H and I, towards the perpendiculars to HI, into lines intersecting the line TS, and coming to the eye of the spectator in the directions SH, SI. This is the case with a single series of particles. Let the body of the sun ED be seen through many strata consisting of many similar circular series of particles, increasing in number and density in the several strata to the surface downwards, a ray of light TS, entering between the strata at right angles thereto, and descending through the lower strata interposed between the luminary and the eye, will be successively bent in the plane of the vertical in which TS is, and a change and elevation of place of the point T in the vertical will be produced. In this manner the points D and E, will be raised to G and F, and all the points between D and E, to places between G and F. But as in passing down between various successive strata, other the rays LH and MI are acted upon by two forces, one between the strata for elevating them vertically, the other by the circular series they enter obliquely for inflecting them towards their perpendiculars, these rays will consequently move in directions diagonal to the directions of these combined forces, and the points L and M will be not only elevated, but dilated externally from and out of the vertical on both sides, and apparently transferred to the points A and B. In the same manner all the rays proceeding from all the intermediate points of LEMD are variously elevated, dilated, and

transferred to intermediate points of AFBG, and the luminary appears, with a smaller vertical, and extended horizontal diameter, of the form of two half ellipses combined on the same major axis, the lower considerably more eccentric than the upper. All rays not passing as above, will be dispersed and lost, or stopped and extinguished, and in an undulatory state of the strata of vapours, the observed undulatory changes of outline and limb, particularly of the lower limb will be produced. All these rays, vertical as well as horizontal, in passing on to the eye of the spectator, will not only be thus inflected and bent, but will be variously distributed, and dispersed into various colours, by the first and successive orders of particles by which they pass, and not only divided, but by degrees entirely separated from the rest of the direct light, in the order of colours from blue to red. First, all the blues will be dispersed, and separated from the rest, and scattered over, and variously reflected by the whole atmosphere, giving it, when seen free from clouds, the usual cœrulean blue, in the manner described in a paper on the Colours of Waters, in the 9th Number, Vol. V., p. 81, of the *Royal Institution Journal*, and never before clearly accounted for. After this separation, the colour of the luminary becomes yellow, until by the increased action of the denser strata of lower vapours, into which it descends, the yellow is entirely separated and dispersed after gilding with its colours the lower surfaces of the horizontal morning and evening clouds, leaving the sun of a bright red sustainable by the eye, and of a lustre continuing to decay, as long as the orb continues to be seen.

The phænomena, thus dependent upon the vapours of the atmosphere for existence, will vary also with these vapours, their quantities contained in air, and their states of perfect or partial solution therein, of more or less absolute separation up to that of rapid precipitation in the form of drops of water. The hygrometer fitted to determine and to measure these changes, of numbers of particles, and of condition of air depending thereon, would obviously be the instrument to be used in observations, rather than the barometer and thermo-

meter, or together with these, inasmuch as the states indicated by these instruments mutually affect each other. In ordinary cases, these instruments may be consulted, but where extraordinary accuracy is required in determining the places of the heavenly bodies, recourse must be had to more direct observations made at the time.

I have thus accounted for the changes of place in the heavenly bodies, the changes of colour, the changes of figure and dimensions, and the occasional undulatory changes of limb and outline, together with the occasional variations even of these changes, by referring them to the same principles, to one and the same existing cause, acting variously, and variously modified; and he who can continue to believe that the apparent increase of size of the sun and moon, in the horizon, is a deception produced by comparison with terrestrial objects, or by assigning them, according to the principles of perspective, dimensions depending upon their places in a supposed less than hemispherical, or rather oblate spheroidical sky, may ascribe all the other concurrent appearances and changes, change of colour, change of place, change of figure, undulatory changes of limb and outline, to delusions, not only ocular but mental, of the mind as well as of the mind's eye. G. W. J.

Art. III. *On the Native Country of the Potato, and on some American Plants. Communicated by* A. B. Lambert, Esq., F.R.S., *&c. &c.*

It has long been a desideratum among botanists to ascertain the native country of the potato, *Solanum tuberosum.* I beg leave now to offer some communications on that subject, which I have lately received in a letter from the celebrated author of the *Flora Peruviana*, Don Jose Pavon, who resided many years in South America, dated, Madrid, September 23, 1817, who says, " The *Solanum tuberosum* grows wild in the environs of Lima, in Peru, and fourteen leagues from Lima on the coast; and I myself have found it wild in the kingdom of Chili. I can assure you this is the truth. The Indians cultivate it in great

abundance in Peru and in Chili, and call it *Papas.* There are other wild species, such as *Solanum montanum* which also gives a *radix tuberosa.*" Of this I have received from the above-mentioned author of the *Flora Peruviana* fine wild specimens with the root. In another letter, dated Madrid, Nov. 10, he again repeats, " I mentioned to you that *Solanum tuberosum* grows spontaneously near Lima, and in the kingdom of Chili, where it was also found by my companions Dombey and Ruiz ;" I have lately received from Don Pavon very fine wild specimens of *Solanum tuberosum*, collected by himself in Peru. Don Francisco Zea, companion and friend of the celebrated Mutis, who long resided in South America, assured me, when he was in this country, that he had often found it wild in the forests near Santa Fé de Bogota, observing at the same time, that the reason why Baron de Humboldt had not found it when he was in that country, was, because he had not time to examine those places where it grew. In a letter (addressed to Mr. Frazer of Sloane-street, Chelsea,) lately received from Dr. Baldwin, an excellent American botanist, who has lately returned from the coast of South America, in the Congress frigate, of the United States, he says, " I found many plants that appeared to be new during my excursion in South America, and had the satisfaction of submitting most of my specimens to M. Bonpland, who has settled himself in the vicinity of Buenos Ayres. It was not the least pleasing of my discoveries to find the famous *Solanum tuberosum* growing spontaneously among the rocks on Monte Video ; in a part of the country, too, where this valuable vegetable is not cultivated. I also found it on the same side of the river in the vicinity of Maldonado." A species of *Solanum* was found by Commerson in the neighbourhood of Monte Video, named by Dunal, in his *Synopsis of the Genus Solanum*, page 5, *Solanum Commersonii*, from a specimen preserved in the Museum at Paris. It is also described in the *Supplement to the Encyclopédie Méthodique*, Vol. III., p. 746. I have no doubt that this is the same with the plant found by Dr. Baldwin. On making inquiry, relating to this plant, of Captain Bowles, who has lately returned from the South American station, and who has

resided for a considerable time at Buenos Ayres, he told me he knew it well, and that it is a common weed in the gardens and in the neighbourhood, bearing small tubers like those of the potato, but too bitter for use. Whether this be the original stock of our common potato improved by cultivation, future observation must determine. Molina, in his *History of Chili*, speaking of the potato, says, "It is indeed found in all the fields of that country, but those plants that grow wild, called by the Indians *Maglia*, produce only very small roots of a bitter taste."

There appeared lately in the English newspapers an account of a root which is very much cultivated in *Peru* under the name of *Arracacha*, and which would be a very desirable acquisition to this country. The before-mentioned Don Francisco Antonio Zea, formerly professor of botany at *Madrid*, who has lately arrived in this country from *Santa Fé de Bogota*, (New Granada,) informs me that the *Arracacha* grows abundantly at *Santa Fé*, *Junga* and *Pamplona*, where it is very much cultivated and eaten in the same manner as we do potatoes in this country; and says that the plant which produces it belongs to the natural order *Umbelliferæ*, and that it has a tapering root, about six inches long and two inches thick. I have little doubt that this is the same with the *Heracleum tuberosum, foliis pinnatis; foliolis septenis; floribus radiatis;* of Molina, who gives the following account of it: "This plant resembles very much in its leaves, flowers, and seeds, the *Common Cow Parsnip*, but is distinguished from it by the greater number of roots it bears, which are six inches long and three inches thick, of a yellow colour, and of a very agreeable taste."

Don Zea has also afforded me another piece of information, relating to a small species of *Mays*, or *Indian corn*, which was introduced last year from France under the name of *Mays de Poulet*, and which ripens its ears two months earlier than the common kind. I had suggested to Mr. Sabine, (who has mentioned it in the *Horticultural Transactions*,) that it was very probably the *Zea Caragua* of Molina; and my opinion is now confirmed by Don Zea, who knew it at once on its being shewn

him. He informs me that it is cultivated in great abundance in Chili by the Indians, particularly in the district called Caragua, whence its name.

I beg leave to mention another communication, also from Don Jose Pavon, relating to a substance which has been several times sent from Spain, under the name of Spanish tinder, resembling very much the Moxa of the Chinese. We never have been able till now to ascertain the plant from which it is manufactured, which proves to be *Echinops Strigosus*. There are three different sorts; the first, *Yesca de Espagna*, or *Amadou d'Espagne, O de Cardo de las flores (ex floribus)*; the second, *Yesca de Espagna*, or *Amadou d'Espagne, O de Cardo de los hogas (ex foliis)*; the third, *Yesca d'Espagna*, or *Amadou d'Espagne O de Cardo de las tallas (ex caulibus.)*

I take this opportunity of inserting another observation which I have also received from Spain.

The tree which produces the balsam of Peru, *Myroxylon Peruiferum*, appears to be the same as *Toluifera balsamum*, or that which yields Tolu balsam. The following account of it is given by Don Hippolito Ruiz: "The balsam of Quinquina is procured by incision at the beginning of spring, when the showers are gentle, frequent, and short. It is collected in bottles, where it keeps liquid for some years, in which state it is called white liquid balsam; but when the Indians deposit this liquid in mats or calabashes, which is usually done in Carthagena, and in the mountains of Tolu, after some time it condenses, hardens into resin, and is then denominated dry white balsam of Tolu, by which name it is known in the druggists' shops." Having examined the specimens of *Toluifera balsamum*, from the *herbarium* of Sir Joseph Banks, I find them exactly the same as *Myroxylon Peruiferum*, and which was sent to Linnæus by Mutis, as the plant producing the balsam of Peru. I have lately received fine specimens in flower and fruit, and also a specimen of the trunk of the tree with the bark on; it is between three and four inches in length and about three inches in diameter, and was collected by the authors of the *Flora Peruviana*.

Art. IV.—*On the Granite of Aberdeenshire, and on the Identity of certain Varieties of Granite, with other Rocks appertaining to the Trap Family.—By* J. Mac Culloch, M.D., F.R.S. *Communicated by the Author.*

It is well known to those who are conversant with rocks, that many members of the trap family, including under that term all the unstratified rocks which lie above the secondary as well as the primary strata, bear a striking resemblance in their mineral composition and general aspect, to some of the varieties of granite; there being comprised under this denomination, all the unstratified rocks which are inferior, not only to the secondary, but to the primary strata. A very remarkable instance of this resemblance, is pointed out in the article which relates to the Isle of Sky, in my work on the Western Islands of Scotland; and similar examples, if less striking, may be seen in many parts of that country, so fertile in all the interesting appearances which are found in the rocks of this multifarious family. The important views that may be deduced from these facts, will be considered hereafter; it being the primary object of this paper, to confirm this important analogy by evidence from a different source, but of the same nature, derived from the existence of those rocks which form some of the most common and conspicuous varieties of the trap family, not only in the situation occupied by granite, but connected with the most authentic masses of that substance by a bond of mutual and imperceptible transition.

Those who are acquainted with Scotland, know that granite occupies an extensive space in Aberdeenshire; and that where it does not appear at the surface, it is covered, and often to a very inconsiderable depth, by different members, both of the primary and secondary strata.

Among these, gneiss is the prevailing rock. In some situations, it forms mountains of considerable elevation, such as Noath and Coreen; but, towards the eastern side of the country, it is found at a general, but irregular low level; like the granite,

with which it is also intermixed in patches of various, often of minute, dimensions, and of very uncertain recurrence.

Micaceous schist also occurs; but towards the western side of the county, principally; as it is scarcely to be found in that tract where granite is the prevailing rock, and which alone is the object of the present paper.

The same remark may be made on quartz rock, which is also found in considerable masses, in some of the western mountains; but it is either rare, or nearly altogether absent, in those places where extensive masses of granite are visible at the surface.

Clay slate occurs in a much more conspicuous manner; forming some tracts of considerable extent and of very moderate elevation; and, in many places, being, like the gneiss, in contact with the granite. It is, further, in some cases, so thin, and so intermixed in patches with that rock, as obviously to form but a very superficial covering over it; the fundamental granite protruding through the schist in many places, in such a manner as to allow its continuity to be inferred, even in those places where it does not reach the surface.

It is unnecessary to notice particularly, the masses of serpentine which are found in many parts of the district under review; and the more rare beds of primary limestone which lie in the western and southern mountains among the other stratified rocks.

These then form the whole of the primary strata which occur in that part of Aberdeenshire now under review. Of the secondary, the lowest or *old* red sandstone is found in different places; but, with one rather doubtful exception, it does not appear that any of the superior secondary strata, whether of sandstone or limestone, exist in any part of this district.

It is, lastly, important to remark, that no instances of superincumbent trap rocks are to be discovered throughout this extensive tract; nor, after a careful research, could I find any veins of these substances. That extensive body of these rocks which occupies so large a portion of the central and secondary

district of Scotland, ceases entirely before the meeting of the strata of this class with the primary ridge which forms the southern boundary of the northern mountainous division of this country. A few veins only, are, in some places, found to penetrate the primary strata in this direction; but, after no long course they entirely disappear.

This slight sketch of the nature and disposition of the stratified and superincumbent rocks which occur in the district under review, will be useful in attempting to trace the general extent and continuity of the granite which forms, not only the basis, but the chief visible portion of that tract which is the repository of the phænomena to be described in this communication.

The most prominent and conspicuous masses of that rock, are those which form the high mountains of Mar, and which contain the sources of the Dee. In tracing from these mountains towards the sea, eastward, the granite is found re-appearing in numerous places; the interruptions to its continuity being produced by portions, more or less extensive, of the primary strata already described, and, principally, of the gneiss. In this manner it may be traced to Portsoy, and, more or less interruptedly round the coast to Aberdeen. Without a map, it would be impossible to convey any accurate ideas of its geographical position and extent; but it will be sufficient here to remark, that two irregular lines drawn from Ben Avon to the places just named, will include the principal part of this rock in Aberdeenshire, and all that which it is necessary for the objects of this paper to notice.

Having formed a geological map of this entire district, I have been enabled to infer, from a comparison of the several apparent portions of the granite, and from the positions and situations of the superincumbent strata, that the continuity of that rock may not only be deduced, but, in many cases, actually traced, in some place or other, in such a manner as to leave no doubt respecting the identity and connexion of the whole. This district must therefore be considered as formed of a

continuous body of granite; covered and obscured, in many places, by portions both of the primary and of the most ancient secondary strata, and appearing wherever these have been removed by those wasteful operations of which this side of Scotland presents so many other striking evidences.

The last very elevated mass of this granite in the north-eastern part of Aberdeenshire, is the mountain Bennachie; but, between this point and the sea to the eastward, it appears, even at the lowest levels; occupying extensive spaces, without the intervention of gneiss or any other superincumbent strata; or, in some places, covered with very thin portions of the former, not exceeding a mile, or even much less, in dimensions. I am induced to notice this tract more particularly, because it is there that the peculiarities about to be described, are most accessible and most conspicuous.

The general continuity of all the granite of Aberdeenshire being thus established, it is next necessary to remark, that, throughout the greater part, it exhibits those mineral characters, which, even by those who imagine that there are distinctions in the relative ages of different kinds of this rock, are considered to be indications of the highest antiquity. The mountains at the sources of the Dee, are well known, by all who have examined this country, to be formed of that granite which consists of quartz, felspar, and mica; and it is, perhaps, unnecessary to say, that the same character pervades the flatter portions to the eastward; as the extensive use of the Aberdeenshire granite in the pavements of London, has made it familiar to every one. It will be necessarily noticed hereafter, that the variety which occurs in Bennachie, presents, in particular, those characters which are supposed to appertain to the most ancient granites; as the quartz and felspar in it, are, in many places, distinctly crystallized.

To this proof of antiquity derived from mineral characters, may be added that which is usually inferred from geological position, by those who contend for this theoretical view of a difference in the relative ages of granite. It is, in most places,

inferior to gneiss; and, if in some, clay slate, or even the red sandstone, is found in contact with it, the continuity of these portions with others which are immediately subjacent to gneiss, is easily traced.

The preceding remarks on the general continuity and common antiquity of all the granite of Aberdeenshire, might have been spared, had this paper been intended for those only, who entertain the same opinions as myself respecting the origin and nature of that rock. But as many geologists still maintain, that granite, like the stratified rocks which cover it, is of aqueous origin, and as they have even imagined a succession of deposits of this rock, some of which they have placed in their hypothetical division of a *transition* class, it became necessary to anticipate the objections which might be urged against the facts immediately to be described, by showing that the writer of this paper had investigated the subject as if he himself had maintained, with them, those opinions which all his observations have taught him to reject.

In traversing this country in the summer of 1819, I was surprised to find blocks of greenstone and of basalt scattered over the surface in different places; particularly, as no indications of trap rocks *in situ*, or even of veins of that nature, were any where to be discovered. These also were every where accompanied by blocks of the common granite of the country; as usual, rounded at the angles by the effects of time. No marks of wear, however, were in general to be observed in the basalts and greenstones; nor did they present those well-known marks of long exposure and distant transportation, which, in the rocks of this family in particular, become very conspicuous after no long period.

Unable, however, to account for them from any other cause, and finding their mineral characters to coincide very accurately with those of the trap rocks of the Western Islands, and of the central district of Scotland, I, at first, naturally attributed their origin to some veins, or insulated masses, which had escaped my observation. But the same substances recurring again in

other places, where, from examining the country around with the most scrupulous accuracy, I was satisfied that no trap rocks existed, I became unwilling to rest in the vague conclusion that they had been transported from some far distant situation, or were the remains of masses long since vanished; more particularly, as they shewed no marks of such transportation, and as it was not easy to conceive that detached blocks of a small size, should remain in a state of integrity, while the larger masses, whence they must have been derived, had disappeared.

Recollecting that the trap rocks so often approximated to granite in their mineral characters, I was thus induced to suspect that granite might also, in the same manner, vary in its characters, so as to resemble the specimens which, in that family, are known by the name of basalt and greenstone; a conclusion the more probable, as many of the fine grained granites in which hornblende enters as a constituent, often resemble some of the greenstones of the trap family; differing from them, principally, by containing quartz; and that basalt, in some of its varieties at least, consisted of the same ingredients as greenstone, in a much more minute and intimate state of mixture.

This suspicion was strengthened by the views, which have long been familiar to myself and to many of the readers of this paper, respecting the common igneous origin of both these classes of unstratified rocks, and I was therefore induced to search more minutely among the solid granite for a confirmation of it. The incumbrance produced by the deep alluvial soil of this country, for some time checked this investigation; but it was at length completed, and in so many different places, as not to leave the shadow of a doubt respecting the nature of the rocks in question, and of their common origin and continuous connexion with the more ordinary granite of the country.

Among other places, I may now point out, for the satisfaction of other geologists, some recent sections of the granite between Old Rain and Meldrum, and at several other points in the same neighbourhood, which cannot be more particularly designated

for want of local references. In these, it is easy to see the transition which takes place between the common granite and these greenstones; and the further change, by which the coarser greenstone becomes a basalt, or assumes an uniform texture in which the separate minerals are no longer distinguishable. If any suspicion had remained that these were veins of trap traversing the granite, they would have been completely removed by examining their forms, their connexions with that rock, and the frequent and imperceptible transitions which occurred between the two; transitions precisely similar to those which take place where ordinary granite changes its character, either by varying its composition, or by an alteration in the nature of its texture.

On a further investigation, it was found that the rocks of this character occurred in very considerable tracts; irregularly intermixed with the common granite, in such a manner as to equal it in quantity, and to remove all possibility of hesitation respecting their continuity and their community of geological origin and position.

It was already remarked, that a part of Bennachie consisted of an ordinary granite, in which the ingredients, and more particularly the quartz and felspar, were frequently crystallized. On the northern face of this mountain, the rocks in question occur in great abundance; passing into the common granite, and forming, in some places, an equally large proportion of the general mass. The want of artificial sections, prevents the transitions from being here seen as clearly as in the places last described; but there is still no difficulty, by the use of the hammer, and with proper attention, in confirming the truth of those views on which it is now unnecessary to dilate any further.

It only remains to describe the mineral characters of the rocks which have thus been shown to form part of the general mass of granite in this country; and that description will still further show the analogy which, in so many other important

points, pervades all the unstratified rocks, however distant in position and in apparent antiquity.

Quartz so rarely enters as an ingredient into these substances, that it may be altogether excluded from the present consideration. The fundamental composition consists of felspar and hornblende; and, according to the magnitude of the parts, and the relative proportions of these ingredients, the appearances of the specimens vary. In some rare instances, the crystals of hornblende are so large as to attain half an inch in length, although they are not defined in form; and as the felspar is commonly white, these varieties form beautiful specimens for collectors of rocks. From this size, the portions of each mineral vary in gradation; forming compounds which are undistinguishable in every respect from the coarser and finer greenstones of the trap family; from those, at least, in which common, and not compact felspar, forms the other ingredient in union with the hornblende.

In all the cases which came under my notice, the hornblende is invariably black, but it is not always intermixed in an uniform manner with the felspar; some instances occurring in which, to the general indiscriminate mixture, are superadded large and distinct patches or irregular crystals; producing that appearance which, when it takes place in ordinary granite from a similar disposition in the felspar, has been called *porphyritic*. In general, the felspar is white, and of that variety which is called *common*. But in the minuter states of intermixture, it has often a greenish hue, and so far loses its crystalline appearance, as to resemble the ordinary compact felspar which is more common in the greenstones of the trap family than the crystallized kind. Whether these varieties, however, actually contain compact felspar, I have not quite satisfied myself; and the confusion which sometimes exists between these two minerals is such, that I am willing to leave this point undetermined; however inclined to believe, that compact felspar occurs in these rocks just as it does in the greenstones of the trap family.

When the mixture of the two minerals, which forms the greenstone of this granite, becomes minute, the rock is no longer distinguishable from ordinary basalt; and, in some specimens, it even appears that the felspar is at length entirely excluded; so that there remains nothing but that compact, yet minutely granular aggregation of hornblende, which, according to some mineralogists, constitutes the only genuine basalt. It is further highly interesting to remark in this case, that these basalts have often that internal concretionary structure which causes them to exfoliate in laminæ on exposure to air; and which is so remarkable a feature, not only in the basalts, but in many of the greenstones of the trap family. I must also observe, that among the rocks of this apparently simple character, there are often found specimens which cannot be distinguished from the black claystones which, by some authors, are also called basalt, and which occur in such abundance in the trap formation. In these, the peculiar lustre which characterizes hornblende is absent; the specimens presenting an uniformly dull aspect, with an earthy fracture and a greater degree of softness.

Although, in speaking of these compounds, I have occasionally used the terms greenstone and basalt, on account of their accurate resemblance to those substances as they occur in the trap family, and because these names are justified by the mineral composition and character of the specimens, they must still be considered as varieties of granite; using that term, in a general and geological sense, to comprise all the unstratified rocks which are found beneath the primary strata, and which, whatever differences they may present, are still associated by some general mineral characters, and by a bond of mutual transition. These terms, however, cannot be applied in this case without great inconvenience; and ought not to be used hereafter in speaking of these substances, whenever the facts now stated shall be admitted by geologists as established. I have, in other writings, pointed out the great, and almost incorrigible confusion, which has already arisen, from applying

the term *syenite* to compounds occurring both in the family of trap and in granite; and the inconveniences of a similar nature which have been produced, by using the term greenstone in the same vague manner. It is evident, that the same confusion, even in a greater degree, would follow from adopting the term *basalt* in the present case.

In every instance in which rocks of a similar nature occur in the primary and secondary classes, it is most important to distinguish them by some expedient; as geological descriptions would either become unintelligible, or be attended with the most inconvenient circumlocution. Limestone has thus been distinguished by the addition of the terms primary and secondary; argillaceous schist, by using, in one case, the denomination of clay slate, in the other, that of shale. In the cases of granite, and of the trap family, the confusion which would ensue from neglecting to make such a distinction, would be even greater than in the stratified rocks. With an origin far distant in point of time, the members of the trap family are not only found in contact with granite, but they also penetrate it in the form of veins. It is scarcely possible, even with all the assistance afforded by a distinct set of terms, to prevent superficial geologists, who are contented with the first and obvious appearances before them, from confounding such recent rocks with the more ancient to which they approximate; and, without such terms, even the most careful observers could not convey accurate information, without danger of misapprehension or without circumlocution.

As an expedient towards attaining this object in the present instance, it might be suggested that the addition of the adjective terms, primary and secondary, would suffice; and we should then have primary and secondary basalts and greenstones. But as the term primary has been sometimes applied, by those who only judge from superficial examination, to the recent veins of this nature which penetrate the older rocks, it appears preferable to abandon its use altogether. Perhaps a better expedient will be found by applying the adjective term granitic to the rocks in question. Thus they may be designated by the

terms, *granitic greenstone*, and *granitic basalt*; denominations, which, while they indicate the geological connexions of these substances, are also explanatory of their mineral characters; and of the relation which, in this respect, they bear to the corresponding rocks of the trap family. It remains for geologists to adopt or reject this expedient as they may see right.

In thus terminating this account of these very interesting varieties of granite, I may be allowed to add, that their history offers a very useful lesson to those geologists who are either content with the first view of things, or who are always ready to determine respecting the appearances which they find, according to some preconceived opinions, or from the vague and superficial notions derived from other teachers than that great instructor, from a careful examination alone of whose phenomena, truth can be elicited. It will also point out the facility with which the most serious errors may be introduced into geological science, by trusting to the mineral characters of rocks, and by neglecting to trace the connexions of such substances with the surrounding masses. If the novelty of the facts which have thus been described, had not rendered the preceding minute details necessary, they would have been still useful to the student, by pointing out the steps which were followed in the investigation, and the nature of the reasoning from which the conclusions were deduced. If his ambition be to extend the boundaries of geological science, if he is not content to repose in the calm belief that every thing is already known, to see through the eyes of teachers, perhaps less competent than himself, and to describe in a received phraseology, appearances, and analogies, which have no existence but in that language which he has been taught, let him be assured that he must bring to his task, industry, patience, and, above all, an unbiassed mind. Nature will neither long deceive nor disappoint him who is only desirous of truth; but the book which she opens to his inspection must be studied with care, and, more especially, with a desire to learn.

Having thus shown the identity of certain varieties of granite, with other rocks appertaining to the trap family, it will be useful to place, in a condensed view, those instances already alluded to in the beginning of this paper, where the members of that family present the characters which are most generally found in granite. A few of them have been pointed out in the author's work on the Western Islands, to which allusion has already been made; but the importance of the subject is such as to demand a more distinct statement of the several facts, while the nature of the present communication affords an opportunity of balancing and comparing them with the analogous phenomena described in it. Thus it will more readily be perceived, that whatever resemblance the most ancient unstratified rocks may sometimes bear to the most recent, corresponding examples are not wanting in the latter of a similar resemblance to the former. That this comparison has never yet been distinctly made, or supported by the evidence of facts, will be an additional reason for extending this paper so as to comprise whatever is necessary for that purpose in the history of the trap family.

In the general, or geological, features of granite and of the trap rocks, there are so many points of resemblance that they cannot fail to have attracted the attention of the most ordinary observers. Granite is never stratified, but is found in shapeless masses which are subjacent to all the strata, of whatever antiquity, near to which they lie. To examine and analyze all the contradictory opinions, which have prevailed on this subject, is here inadmissible; but it may be remarked, in a general way, that the adduced instances of stratification in granite, may all be referred to the laminar concretionary structure on the large scale; or are portions of gneiss of which the texture so often becomes perfectly granitic; or, lastly, are veins of that rock traversing the gneiss in directions parallel to its stratification.

The trap rocks are also unstratified; or, in the predominant instances at least, these irregular forms prevail, while the masses differ from those of granite in being superior to all the rocks which they accompany. Instances of a disposition which has

been esteemed a true stratification, are however not uncommon among the rocks of this family; but these, whatever resemblance they may bear to genuine stratification, admit of other explanations. Into the details of these it is also impossible here to enter, as it would involve a long train of facts and discussions. It must suffice to say, that all the instances of stratified trap yet produced may be easily explained, and are, indeed, in most cases, demonstrably proved to be either veins parallel to the strata in which they lie, or thin superincumbent masses of which the forms have been determined by those of the subjacent stratified rocks; or else strata of shale, or of other substances, which have been converted into trap by the same causes which sometimes change them into siliceous schist; or, lastly, tufaceous rocks which appear to have been either deposited in the shape of mud, as similar materials so frequently are by volcanic eruptions, or else generated, like the sandstones, from the wear of more ancient rocks of the same nature.

Granite, and the trap rocks, are both found in the shape of veins, and they are the only rocks which are known to be disposed in this manner, it being here understood that, under the term *trap*, is included every instance of porphyry, as well as those varieties which are peculiarly connected with the most recent greenstones, basalts, or claystones. It has indeed been asserted, that sandstone and limestone, and even clay-slate, have been found forming veins, but it is easy to see that these imaginary observations are either the result of ignorance or inexperience, or are the produce of something more than voluntary self-deception for the purpose of supporting an hypothesis.

The veins, both of granite and of trap, have, in so many instances been traced to principal masses of the same rocks, as to leave no reason to doubt that this character is, in both, universal. In both cases the want of free access occasionally prevents these connexions from being ascertained; in the trap-rocks another cause sometimes interferes with this investigation, namely, the entire loss, from the effects of time, of the great superincumbent masses, while the veins remain, protected from destruction by the strata in which they lie.

Both these classes of veins ramify, by subdivision, as they proceed from the central or principal masses; but that feature is most common in granite, while the veins of trap also differ from them, very generally, in holding much longer courses without any change of dimension. These differences, however, do not destroy the analogy which subsists between these two rocks; and they admit of explanation by collateral circumstances which need not be examined in this place.

The passage, both of granite and of trap veins, through strata, is accompanied by peculiar appearances which are, in both cases, of a similar nature, and which often, indeed, correspond very accurately. In their immediate vicinity the strata are displaced, distorted, or broken. In the case of trap also fragments of the adjoining rocks are often entangled in the vein; and if that occurs less frequently in granite veins, it still happens sufficiently often, both in these and at the contact of the larger masses of granite with the strata, to justify that general analogy which is alone contended for in this place.

The alterations in the mineral characters of the strata, which occur at the junctions of these two classes of rock, are also in both cases of a similar nature, resembling each other in their general features, and only differing according to the previous characters of the strata subjected to this influence. In both instances of these junctions, the argillaceous schists are indurated and changed into siliceous schist. In some, the contact of a granite vein converts that schist into hornblende, while the contact of trap with the secondary argillaceous schist or shale, frequently produces a substance scarcely differing from basalt, and thus far analogous also to that mineral, which forms the principal ingredient of this rock. The effects produced on limestone, in both cases, correspond still more accurately and obviously, because the limestones of the primary class, which are those alone traversed by granite, differ less from those of the secondary, which are principally subject to the influence of trap, than any other of the analogous strata in the primary and secondary classes do from each other. Such limestones, when impure, or containing much siliceous and

argillaceous earths, are in both cases, converted into substances resembling chert. Where, on the contrary, they consist of carbonate of lime alone, they assume a crystalline texture near the points of junction with the veins; and the causes of that change are very obvious in those instances where, in the distant portions of the rocks, these limestones have a compact or earthy texture, as is particularly the case where chalk is traversed by trap veins. If, in other cases, the veins of granite produce less effect on the adjoining rocks than those of trap, it must be recollected, that the former traverse exclusively the primary strata, of which the mineral characters are such as to be scarcely capable of undergoing those changes which, in the contact of trap with the secondary strata of softer texture, are easily induced.

On this subject of the general analogy between these two classes of veins, it may lastly be remarked, that where granite ramifies into minute filaments, the mixed crystalline texture disappears, and the ultimate branches become uniformly compact, appearing to consist of an intimate mixture of quartz and felspar, or of felspar alone. In the same manner, where trap veins have been found ramifying in the same way, the minute branches lose the crystalline character and acquire a fine compact texture, so as to resemble either pitchstone, or that siliceous schist which is called Lydian stone. Such ramifying veins, it is true, are rare, but they have been pointed out, in that work on the Western Islands already mentioned, in several places, namely, in Barra, South Uist, and Sky.

To enter further into this subject, and to support it by all the evidence of facts which might be brought forward for that purpose, would be to involve the whole history of these two remarkable and extensive classes of rock, and, in fact, to produce a treatise utterly incompatible with the nature of this communication, and with the space to which it is unavoidably limited. Practical geologists will be at no loss to supply, from their own knowledge, whatever is wanting; and those to whom geological investigation is yet new, or who have suffered themselves to be diverted from the study of nature by hypo-

thetical dogmas, will thus be directed to the use of their own faculties in observing the phenomena which they may witness, and to the exertion of their own judgments in reasoning from them.

Having thus pointed out the geological resemblances which exist between the trap rocks and granite, it is necessary to advert to one important point of difference, on which a greater stress has been laid than the circumstances appear to justify.

It has been remarked, that although the former are found to lie above the secondary strata, which they chiefly accompany, granite is never found in the same manner lying on the primary. Hence it is argued, that, even if the igneous origin of trap be admitted, the defect of this important feature in granite, is a sufficient reason to refuse to it a similar origin.

There are many collateral circumstances, however, to be considered, before the justness of this reasoning can be admitted. The principal of these relates to the waste which the surface of the earth has undergone; but, on this subject, I need not repeat that which is already familiar to geologists, and which consists merely of general reasoning derived from analogies. If indeed the instance quoted by Mr. Von Buch, in Norway, of granite incumbent on conchiferous limestone, and the similar fact immediately to be described as occurring in Sky, be admitted as examples of real granite, the doubt in question is removed, and the fact of the superincumbence of that rock is established.

But it will be seen hereafter, that no advantage is taken of these examples, as they are considered to be modifications of the trap family. The term *granite*, here used in a strictly geological sense, is limited to all the rocks of this character which are subjacent to the primary strata only, or, when both classes occur together, to both. The veins which proceed from it also penetrate the primary strata only, and not the secondary, and thus it is proved to be of a date prior to the deposition of the latter. In this rigid view, therefore, of the meaning of the term granite, if ever it is found in a superincumbent form,

it must lie on the primary strata alone, and not on the secondary, and thus also it might exist in masses intermediate between these two classes of stratified rocks. We are by no means sufficiently acquainted as yet with the multitude of existing appearances to pronounce a negative on this subject; and the difficulty of investigating accurately phenomena of a much more obvious and simple nature, will teach experienced geologists to reserve their opinions respecting it for a period of greater information.

It has moreover been shewn in this paper, that greenstone and basalt, or rocks identical with these in their mineral characters, occur as varieties of the most decided granite; and it must also be well known to all observers, that the limits between granite and some of the porphyries connected with it, are frequently evanescent. It is therefore far from improbable that some of the superincumbent masses of these substances which are found on the primary strata, are truly connected with subjacent granites, and are modifications of that rock, not of those of the more recent trap family.

Having thus stated the geological resemblance which exists between granite and the trap rocks, and having, in the preceding part of this paper, pointed out the identity in mineral character between certain varieties of granite and others appertaining to the latter family, it remains to enumerate some of the most remarkable instances in which the trap rocks assume those characters which are predominant, and have been esteemed essential, in granite.

In the island of Sky there is found a body of primary strata, succeeded by a tract of secondary limestone, shale, and sandstone. This secondary tract is, throughout the greater part of its extent, covered by an immense mass of trap rocks, the proofs of their superincumbent position being displayed very distinctly in many places. Most of the varieties of this family which are as yet known, and one which exists only here and in the neighbouring land of Airdnamurchan occur in this space, and the whole of them are connected by imperceptible gradations.

Among these is found that compound of felspar and hornblende, with excess of the former mineral, to which the term *Syenite* has been applied, and to which, together with the analogous rocks of the same family, it is here exclusively limited. On one side, this rock passes into porphyry in the usual manner; or, by the loss of its hornblende only, into a simple rock, which in the same imperceptible manner, graduates into claystone. But, in another part, quartz, and subsequently quartz and mica both, are superadded to the compound of hornblende and felspar; and thus there is produced a rock, in no way differing from many varieties of ordinary granite, and, in particular, strongly resembling some of those which occur in Arran. The connexion of this *granite*, or rather syenite of a granitic character, with the adjoining ordinary trap-rocks, is such as to admit of no doubt respecting its identity of origin; and it is unnecessary to say that it is thus proved, even if more distinct evidence of that circumstance were not accessible, to be superincumbent on conchiferous limestone. The instance already mentioned as described by Mr. Von Buch, must doubtless be considered as of the same kind; and even those who would otherwise be inclined to withhold their assent from this view of its nature, will probably choose to adopt this conclusion, rather than to admit of a granite more recent than the latest secondary strata, or of one which occupies that superincumbent position, the existence of which has been refused to those who argue in favour of its igneous origin.

In St. Kilda, there is found a mass of trap, consisting chiefly or entirely of that variety which I have called *augit rock*, connected with a syenitic rock in which hornblende and felspar form the chief ingredients, but which also contains quartz. Although no stratified rocks are found in this island, it may be concluded, from the mineral characters of these rocks, and more particularly from the presence of augit, which exists as an essential contituent only in the trap family and in the volcanic rocks, that St. Kilda belongs to the family of trap, and not to that of granite.

In this syenite cavities are of frequent occurrence, containing

both the felspar and quartz in a crystallized state, and very nearly resembling, in this respect many of the granites of Bennachie, already mentioned, as well as some of those which occur in Arran. The quartz, in particular, is remarkable for bearing those characters which it so often presents in granite, being brown, and often crystallized in its most ordinary form, so as to attain an inch or more in length. It is remarkable that the same circumstance occurs in the quartz belonging to the granite of Arran, in a manner so exactly similar that the specimens are undistinguishable.

Among the varieties of trap occurring in Sky is found a compound of hypersthene and felspar to which I have given the name of *hypersthene rock.* In its external general forms, the aspect of this rock is such as to be undistinguishable from that of granite. Like this, it is found in huge curved beds, sometimes divided into prismatic and cuboidal forms, and rising into those sharp and permanent peaked summits, which are so often characteristic of granite, and which have indeed been deemed peculiar to it. Although the mineral composition of hypersthene rock is entirely different from that of any granite yet known, the texture is the same; and it is further highly worthy of remark, that, in some places, it assumes the foliated tendency of gneiss, from a peculiar parallel disposition of the crystals of hypersthene. Further, in many parts, it contains garnets, disposed in the same manner as they often are in granite, and of the same character.

That the ordinary greenstones of the trap family sometimes resemble those similar compounds found in granite, by containing quartz, is matter of such general notoriety that it is unnecessary to describe the examples. Nor is mica necessarily excluded from these, although it must be considered as a rare ingredient. With respect to the texture of the rock, or the magnitude and disposition of the integrant minerals, it may be observed, that the greenstones have a character which is often perfectly granitic, the felspar and hornblende being distinctly crystallized on a very large scale, and interfering with each other's regular forms. The neighbourhood of Edinburgh pre-

sents numerous and remarkable examples of this nature: and, in that neighbourhood also, are to be found masses of ordinary greenstone incumbent on the most recent strata, the forms of which so perfectly resemble those of granite, in the prismatic division of the parts and the subsequent rounding of the angles, that they are undistinguishable without manual examination. The Corstorphine Hills contain the examples of this latter occurrence, as the rocks near the Queen's-ferry do those of the highly crystalline texture.

Having thus pointed out, in a general manner, the resemblances that occur between some of the rocks which belong to granite and others which are members of the trap family, I may notice, but in the briefest manner, the most conspicuous differences which exist between them. Those of a geological nature have been sufficiently described in treating of the points of resemblance in this respect; and it only remains to notice more particularly those differences in the mineral composition and character which have not been so fully stated as they deserve.

In respect to the mineral ingredients, the two substances, felspar and hornblende, occur abundantly in both divisions; but, in granite, quartz and mica are very common and conspicuous, whereas, in the rocks of the trap family, they are exceedingly rare. In the latter, compact felspar is also a very common mineral, but it occurs in granite rarely and in small quantities, apparently rather as an accidental than an essential substance. Augit, also, and hypersthene, which I have pointed out as ingredients in some of the trap rocks, have not hitherto been found in any varieties of granite.

With regard to the several rocks of the trap family, it has been a principal object of this paper, to show that greenstone, basalt, and even claystone, occurred as varieties of granite. It is yet uncertain, as before remarked, whether porphyry may not also, in some cases, be a member of the granite family; but, whether it be so or not, the limits between the two are often very evanescent. In granite, however, no instances have

yet occurred of substances resembling clinkstone; and if the amygdaloidal structure never occurs in that rock, that circumstance is easily explained by the peculiar conditions necessary for the production of that cavernous structure from which the amygdaloidal seems to arise. That a large proportion, at least, of the amygdaloidal nodules, are the result of a subsequent infiltration, is proved by circumstances which I have stated in other places, but into the details of which I cannot here enter.

In comparing, finally, the mineralogical differences of these two classes of rock, it must be observed, that they consist more in the relative proportions of the several varieties in each, than in the different characters of those members, separately considered. In granite, the well-known compounds to which this name is generally applied, abound almost to the exclusion of those which have here been described, and that resemble the rocks of the trap family. In this latter division, on the contrary, greenstone, basalt, and claystone, are among the prevailing substances; while the compounds that resemble granite are very rare.

But, that too much stress may not be laid on the differences which have here been pointed out, it is proper to remark, that the several members of the trap family, differ as much among each other, as the whole, collectively taken, differs from the rocks that rank under granite. Even in comparing the individual members, the contrast between the softest claystone and the syenite of Sky, or between that simple rock and the numerous porphyries which are found in this family, is as great as that which exists between the same substance and granite.

It is not one of the objects of this paper, to protract this examination of the analogies and differences between granite and the trap rocks, further. To enter more deeply on the discussion, would require a space exceeding the limits assigned for it; since it would be necessary, among other matters, to point out all the circumstances in the origin of both, and all the probable causes which, in either, might have produced those appearances which are not at all to be found, or exist more

rarely in the other. It is sufficient to have indicated some facts, hitherto unknown, which add a mineralogical resemblance to those formerly acknowledged to exist between two classes of rock so remote in origin, and to have given a brief sketch of the other circumstances of analogy which were required to illustrate the main object for which these facts have been brought forward. Those who may hereafter examine this question as a matter of geological theory, and as connected with the causes which have influenced the dispositions and the characters of the rocks that constitute the visible portion of the earth, will thus be furnished with additional facts from which to reason.

But if, in the present state of geological science, the collection of facts is necessary, it is not the less incumbent on the observer, to reflect on the main object to which all such facts are destined, and to keep steadily in his view the great purposes of all such investigations, namely, the establishment of analogies, and the discovery of those causes, a knowledge of which is no less useful as a guide to our inquiries, and as forming an indispensable part of the science, than it is an invincible desire in all inquiring minds. In concluding this communication, therefore, I shall, in the briefest possible manner suggest those reasonings which the facts in question appear to indicate.

The arguments by which the igneous origin of the trap rocks is supported, are so well known that they do not require to be repeated; were it even one of the objects of this paper to enter on the general merits of this question. That doctrine is now indeed so universally received among all those who have shaken off the bondage of authority, and who have both the capacity and the inclination to observe and to reason for themselves, that it may be considered as established. But the phenomena displayed by granite, although, in the most essential points, resembling those which occur in the trap family, have as yet failed to produce the same general conviction with regard to the igneous origin of that rock. Into the arguments of a geological nature by which this doctrine may be supported, I

shall not here enter: it is sufficient that the chief points have been indicated in a preceding part of this paper. Limiting the present remarks to deductions from the corresponding mineral characters of trap and granite, which have here been pointed out, the following conclusions appear justifiable.

It is found that many important points of resemblance occur between the mineral composition, the texture, and the general structure and disposition, of many rocks in the trap family and others in the family of granite. More particularly, it has been pointed out, that, among the former, there occurs a compound in no way differing from one of the most abundant varieties of the latter. As the trap rocks are admitted to be of igneous origin, it may be inferred that the same cause which has produced the granitic variety of this division, has also operated in the production of the corresponding substance in the family of granite. Again, it has been shown that in granite there occur varieties, in no way differing from some of the prevailing rocks in the trap family. Thus the analogy between the two is still more closely drawn, and thus also it may be inferred, that if in the latter, these rocks must be attributed to an igneous origin, in granite also they have originated from the same cause. And if, in this rock, it be admitted that any of the varieties have an igneous origin, it is not easy to see on what ground it can be denied to the remainder.

To complete this analogy, it would have been necessary to inquire, to what circumstances it is owing that the compound, which is among the most rare in the family of trap, is the most abundant in that of granite; and that, on the other hand, some of the most rare varieties of granite are abundant in the trap family. But this inquiry is too speculative for the purposes of the present paper, and of too discursive a nature to be admissible within the limits to which it is restricted. Those geologists who have turned their attention to this subject, will find no difficulty in pursuing that train of reasoning which the author of the present communication thus leaves in their hands.

J. M.

June, 1820.

Art. V. *On the Employment of Common Salt for the Purposes of Horticulture. By* Samuel Parkes, F.L.S., *&c.*

[This Essay, extracted from the Horticultural Memoirs of Edinburgh, was rewarded by the Prize Medal of the Caledonian Horticultural Society for 1819.]

As a science, *Horticulture* is comparatively but of a modern date. It was unknown both in Greece and in ancient Rome; for in all the accounts which we have of the baths, the grottos, and the aqueducts, which were considered so ornamental to their cities, there is, I believe, nothing described which conveys any idea whatever of our modern gardens. The Britons, like the Romans and the ancient Germans, made use of herbs and fruits; but, according to Strabo, they were such as grew in the fields and woods, without cultivation. Indeed it has often been questioned, whether the hanging-gardens of Babylon, of which so much has been said, were not more for the display of an original kind of architecture, or for the ostentatious exhibition of ornamental and expensive sculptures, and enormous idols of gold and silver, than for any purposes of real utility.

Even in the Augustan age, when the wines of Italy were in general estimation, little was known of the true method of cultivating the vine, as appears from a story which is recorded by Pliny. He relates that a celebrated grammarian, who lived in the reign of Tiberius *, bought a vineyard, which had been so much neglected by its former owner, that it had become almost barren; and that when, by care and attention, he had rendered it fruitful, his neighbours, who had no idea that trees could be so im-

* In a century or two after this period, it is probable that the Romans had acquired more knowledge of the management of vineyards; for we read that, about A. D. 278, the settlers in Britain, finding that some parts of the island were not unfit for vineyards, obtained permission from the Emperor Probus to plant vines here, and make wine from their produce.

proved by cultivation, and whose vineyards had always been much less productive, propagated a story that he had procured such unusual crops by the arts of magic and sorcery*.

It likewise appears from a variety of testimony, that the ancients were equally ignorant of the methods of rearing shrubs, herbs, and plants. Such of these as were cultivated, were preserved merely for the purposes of medicine; and though the medical professors had this stimulus, their knowledge of varieties seems to have been very limited. Theophrastus, a writer of great credit, who carefully collected plants as well as minerals, and who collected not only those of Greece, but travelled in Egypt, Ethiopia, and Arabia, for the improvement of science, was able to obtain only 600 species. M. Rollin, however, tells us, that when, by order of Pope Nicholas V. in the middle of the 15th century, a translation of the work of Theophrastus was printed, the physicians of that day, perhaps the only class of men who attended to the orders of plants, were so dissatisfied with the narrow limits of botanical knowledge, that resolutions were taken to go in quest of it to the very places whence Theophrastus and others of the ancients had written. He adds, that in consequence of these decisions, voyages were made to the islands of the Archipelago, to Palestine, to Arabia, and to Egypt; and these expeditions were attended with so much success, that in the beginning of the 16th century, the learned were in possession of the description, not of 600 only, but of more than 6,000 plants, with engraved figures of each†.

It seems, however, that Botany did not obtain much of the appearance of a science until the beginning of the last century, when Louis XIV. with the munificence becoming a great prince, commissioned Mons. Tournefort to make a botanical excursion through many of the provinces of Asia and Africa, to collect plants, and to make observations upon natural history in general. This great man received the king's order in the year 1700, and although he was driven home in 1702, by the fear of the plague which then raged in Egypt, he brought

* *Pliny*, lib. xiv. c. 3.

† *Rollin's History of the Arts and Sciences of the Ancients*, vol. iii.

home so many new plants, that he could enumerate 1,356 distinct species, without including any of those which he had collected in his former travels.

The learned throughout Europe were proud of these achievements, and Tournefort was considered to be one of the greatest ornaments of France. In England, however, we had the excellent and eminent John Ray, a man whom we had equal reason to value and admire, who indeed rather preceded Tournefort, and was equally assiduous in his endeavours to promote the knowledge of plants. In consequence of the exertions of this great man, and of the methodical arrangements which he had formed of the vegetable kingdom, together with the subsequent labours of Boerhaave, Linnæus, Hudson, and others, botany, about the middle of the last century, assumed a distinguished rank among the sciences of Europe.

Such are the fruits of industry, when directed by taste and by the energies of an enlarged mind; but the discovery and arrangement of new plants were not the only benefits that were achieved by the exertions of a succession of great men, all directed to the attainment of one important object; for with the knowledge of plants, the want of gardens increased*; and as these became more common, the public gradually acquired a taste for planting, until the desire of possessing a garden became general throughout Europe.

The changes which this produced in society were many and important; and, I have no doubt that, a person now travelling through Europe, and making this one of the objects of his inquiry, would find the character of each people more or less favourable, according to the degree in which a taste for gardening prevails among them. Were I asked to enumerate the

* I am aware that there were gardens in Great Britain before the Norman Conquest, belonging to the monks, but the inhabitants in general had not this useful luxury. There were also large vineyards here in the 12th century. William of Malmesbury says, that the grapes produced in the vale of Gloucester were of the sweetest taste, and made most excellent wines, but these were likewise the property of the great barons, the monks, and abbots: for the general inhabitants of the country participated neither in the credit nor profit which was attached to these establishments.

causes which produced that increase of civilization, which has gradually taken place during the last two or three centuries, I should most certainly place the introduction of gardening next to the invention of printing. The possession of a garden has a natural tendency to soften the character of the most ferocious; it attaches a man to home, and doubles the value of his habitation; and whenever its cultivation is engaged in with ardour, it not only affords an innocent means of occupying leisure hours, but it has also the important effect of diverting the attention from all low and unworthy pursuits.

Buffon, the celebrated French naturalist, was so enamoured of his garden, that he erected a pavilion within it, in which he could study with convenience. There he usually retired at five o'clock in the morning, and was then inaccessible. Prince Henry of Prussia named this sylvan retreat the "cradle of natural history." The illustrious Lord Bacon has pronounced gardening to be the "purest of human pleasures, and the greatest refreshment to the spirit of man."

The dissemination of a taste for gardening is, in my opinion, one of the most valuable effects of the establishment of all horticultural societies; and I have no doubt but that, in this way, the Caledonian Horticultural Society will be found to be eminently useful. While addressing the members of this respectable association, I hope I may be allowed to say, that I feel proud of having been enrolled among those whose efforts tend not only to the improvement of natural history, and rural economy, but also to the promotion of moral habits and propensities. Penetrated with these feelings, I shall greatly rejoice if the following observations and collection of facts, upon a subject in which the public seem now to take considerable interest, should in any degree excite a general desire in others to further the important objects of the Society.

The subject which I have now chosen for discussion and investigation, is the application of *Common Salt to the purposes of Horticulture*, the several branches of which I propose to consider in the following order:

1st. That common salt, when applied in due proportion,

has the effect of promoting the health and growth of vegetables.

2dly. That it has the property of rendering fruit trees and esculent plants unfit for the food or the habitation of worms and insects.

3dly. That common salt is one of the most efficacious substances that can be employed in a garden for the destruction of worms and insects; and

4thly. That common salt may, with material advantage, be likewise used for the destruction of weeds, or other noxious vegetables.

Under the first division of our subject, it is to be observed, that the celebrated Dr. Darwin, when treating of common salt as a manure for land, asserts, that this substance "is a stimulus which excites the vegetable absorbent vessels into greater action than usual, and that in a certain quantity, it increases their growth, by enabling them to take up more nourishment in a given time; and consequently, to perform their circulations and secretions with greater energy." Sir Humphry Davy, from what he says in his *Agricultural Chemistry*, seems, on the other hand, to think it also probable, "that common salt acts as a manure, by entering into the composition of the plants, somewhat in the same manner as gypsum, phosphate of lime, and the alkalies."

These opinions will be thought to have great weight; but as few persons, comparatively speaking, will be able to confirm them by their own experience, in consequence of the very limited attention that has hitherto been bestowed on the use of salt in horticulture, the more useful way, perhaps, of treating, this subject, will be to lay before the Society the evidence of those practical men, who have already published the results of their experiments, and then to draw such conclusions as their communications may seem to justify.

Dr. Brownrigg, who, in the year 1748, published a valuable work "*On the Art of making Common Salt,*" makes the following statement:

"Salt," says he, "contributes greatly to fructify the earth, and when properly used as a manure, affords ample nourish-

ment to corn and other vegetables, and renders kingdoms rich and fertile, where it happens to abound in the soil." p. 158.

Mr. Hollingshead, a gentleman of considerable fortune, who resided near Chorley in Lancashire, and spent many years in making experiments on the application of common salt as a manure, and who also made powerful efforts to obtain a repeal of the salt laws, published a few years before his death, a very interesting pamphlet on the subject. In this work, to which I am greatly indebted for much useful information, he relates, that " when foul salt was permitted to the farmers duty-free, a person near Middlewich in Cheshire trenched his garden in autumn, mixing with the soil a quantity of foul salt. The following spring, it was dug or delved in the usual method, and planted with potatoes. The crop produced therefrom was such as far exceeded his most sanguine expectations. Twenty of the potatoes were produced, which weighed sixty pounds."

Several other testimonies to the beneficial effects of common salt in the culture of the POTATO might be produced, but I recollect none so decisive as that of the Reverend Dr. Cartwright, which is published in the fourth volume of the *Communications to the Board of Agriculture.*

Having previously prepared a piece of land for the experiments, on the 14th of April 1804, a portion of the land was laid out in beds of one yard wide and forty yards long, twenty-four of which were manured in different ways; one of the beds had no manure, and fifteen of the beds had salt put upon them, in the proportion of a quarter of a peck to each bed. On the same day the whole was planted with potatoes, a single row in each bed; and that the experiment might be conducted with all possible accuracy, the same sets were planted in each bed. On the 21st of September, the potatoes were taken up, and the produce of each row was accurately ascertained; from which it appeared, that in every instance excepting one, where the salt was used, the crop was found to be superior; so that, of ten different manures, most of which are of known and acknowledged efficacy, salt proved superior to them all, one only

excepted, *viz.*, chandlers' graves; and that bed in which salt and soot were combined, produced of all others, the *best* crop. But the most singular circumstance, and that which has induced me to submit the relation of this experiment to the Society, is, that where salt was used, whether by itself or in combination, the roots were entirely free from the scabbiness to which potatoes are often liable, and from which none of the other beds were altogether exempt, although there were in the same field nearly forty beds of potatoes, besides those which were planted for the sake of these experiments.

In the culture of the TURNIP, salt is also very efficacious. In the twenty-seventh volume of the *Annals of Agriculture* is a paper communicated by Davies Giddy, Esq., President of the Penzance Agricultural Society, which contains an account of some very important experiments on this subject. At Michaelmas 1790, Mr. Sickler, a member of the Society, entered upon an estate, so much impoverished by the former tenant, as scarcely to return the value of the seed. In the spring of 1791, Mr. Sickler prepared two acres for turnips, which had borne seven crops of oats in succession. The last crop did not produce nine bushels on an acre. In the first week of April, the earth from the ditches was carried into the field, and laid in four piles; each received three cart-loads of sea-shell sand, and five bushels of salt. The earth from another ditch, chiefly consisting of the decayed soil, which had been taken off the ground in former tillage, was placed in three more piles, and each of these received also three cart-loads of sand, but no salt, on account of the apparent richness of the earth. Half the field was manured with the four first piles; but the three last not being sufficient for the other half, what remained without manure was sown with salt, at the rate of ten bushels to an acre.

That part of the field where salt had been used, either mixed with earth or alone, produced about half a crop of turnips, but the crop totally failed where there was no salt.

In 1792, three acres, which in 1791 had borne a crop of wheat, not exceeding twelve bushels on an acre, were ploughed before Christmas, and brought into fine tilth by midsummer fol-

lowing. On each acre were sown twenty bushels of salt, excepting that two ridges towards the middle of the field were purposely left without any salt; on these two ridges the turnips totally failed, but the remainder of the field produced a plentiful crop.

In 1793, four acres of land, completely worn out by successive tillage, were ploughed before Christmas; three acres were sown with salt, at the rate of twenty-five bushels, and the remaining acre with eighteen bushels, without any other manure. The crop was in general a good one, but visibly best where the greatest quantity of salt had been used. Since that time, crops of turnips have been raised, with equal success, by the use of salt; and in the severe winter of 1794-5, it was observed that these turnips were much less injured by the frost, than others similarly treated and cultivated in the common way. The writer of the account suggests, that if turnips are less injured by frost when they are manured with *salt* than when they are cultivated in the usual manner, it must indicate an extraordinary degree of health and vigour in the plant; but a single observation is insufficient to establish such a fact.

The free use of salt, in the culture of the CARROT, has also been found very efficacious. The effect of enlarging the growth and consequently increasing the crop of all esculent vegetables, has long been known to all the gardeners in America. Sir John Sinclair likewise informs us, that drilled carrots grow well in a salted bed, the salt being laid under the surface, in the centre of the intervals between the rows, and at some distance from the roots, in such manner, that it may be dissolved before the fibres of the roots meet it. See *Husbandry of Scotland*, second edition, vol. ii., Appendix, p. 182.

Some years ago, Baron Humboldt discovered that a weak solution of any of the oxymuriatic salts has the property of accelerating and increasing the growth of vegetables. This effect is probably owing to the circumstance of the oxymuriates being converted by exposure to the air into common muriates. It might, however, be within the scope of your Society's plan and intentions to offer premiums to such gardeners as would willingly make farther experiments on bleachers' residuum, an

article which may be had for little or nothing, and which, if divested of the sulphate and muriate of manganese, which is always contained in it, would doubtless prove a very powerful and beneficial manure.

A gardener of considerable celebrity at Chorley in Lancashire, of the name of Beck, made use of common salt in his extensive gardens for upwards of thirty years, especially upon his ONIONS, and he found that the application of this salt very far surpassed that of all other manures. He never took any care to ascertain the exact quantity of salt which he employed; but when he was questioned as to this point, he said, that he thought he was accustomed to use it in the proportion of about sixteen bushels to an acre of land. His practice was to sow the salt immediately after he had covered in the seed, a point which should always be attended to, because it has been found, that, if the salt be sown after the plants show themselves above ground, the whole crop will inevitably be destroyed. On the contrary, if a moderate quantity of salt be sown upon the land as soon as the onion seed is deposited in the ground, say about six pounds to one square perch of land, or four ounces to a square yard, the result will not fail to be striking and advantageous.

The general failure of the onions last year has been much spoken of, but I do not hear of a single gardener that employed salt who had not a very abundant crop. As a corroboration of this, I may refer to the letter of Mr. William Morton of Biel, which was read to our Society on the 8th of September last, and which states the benefits he had derived from the use of brine, made by the solution of common salt in water, and which he had applied to his beds of onions, shallots, and other roots. I shall, however, have occasion, before I conclude this address, again to refer to Mr. Morton's letter.

Seeing that common salt produces such striking effects in the culture of potatoes, turnips, carrots, onions, shallots, &c., I cannot help being surprised that it has not been brought into general use long since, especially as I observe, that more than 200 years ago, the Lord Chancellor Bacon, in the most unequi-

vocal manner, recommended its employment in the practice of horticulture. His words are these: "Several herbs, such as radish, beet, rue, pennyroyal, like best being watered with salt water; and I advise the extension of this trial to some other herbs, especially those which are strong, such as mustard, rocket, and the like.—*Lord Bacon's Natural History.* I must, however, now proceed to the consideration of the effect of salt in the cultivation of fruits.

The action of common salt upon FRUIT-TREES, when judiciously applied, is equally beneficial. In cider countries it has been the practice on some estates, where the owners have been ambitious to have fine orchards, to dig a small trench a few yards distant from each apple-tree, and to put within it a small quantity of salt, which, by means of the rain, becomes dissolved, and is gradually conveyed to the roots of the trees. This practice is said to increase the quantity of the fruit, and to preserve the trees in the utmost health and vigour.

Mr. Hollingshead, whom I have before mentioned, and who studied this subject for many years, remarks, that "Those farmers who reside near the sea-shore, might derive considerable advantage from watering their grounds with sea-water, or sowing them with sand from the beach, below high water-mark, during the spring and autumn, as the particles of salt contained therein would be a great benefit. Fruit-trees," says he, "and the hop plant should also be sprinkled with sea-water, or have salt or sea-sand laid about them at some distance from their stems. The cotton-tree and sugar-cane, in the West Indies, would also derive considerable advantage from this mode of treatment." Page 21.

There is a very striking experiment on record, which was made by the late Mr. Gilbert, steward to the late Duke of Bridgewater, on the effect of common salt upon apple-trees; and from my own knowledge of that gentleman, I have no hesitation in saying, that I believe the account may be strictly relied upon. This gentleman, who was not only steward to the Duke, but also a large salt manufacturer, had an estate contiguous to his salt-pits at Wincham in Cheshire, on which was an

orchard planted with apple-trees, which, being grown old, constantly bore in the spring a profusion of blossoms, but never brought any fruit to perfection. To remedy this defect, the tenant spread a quantity of rock-salt, bruised small, about each of the trees, at some distance from their stems; and ever since that period all the trees in that orchard have continued to be very productive, yielding abundance of fine, large, and well-flavoured apples.

A merchant at Liverpool, with whom I am well acquainted, has sent me an extract from a letter which he received from a very respectable correspondent, on the state of the fruits in the gardens at Droitwich, a town in Worcestershire, which is one of the most considerable places in Great Britain for the manufacture of common salt. It runs thus:

"It is a remarkable circumstance, and worthy observation, that about the 15th of July, when the small fruit began to fail, and become scarce in the markets, in consequence of the great drought, the fruit in the gardens at Droitwich had not the least appearance of the want of rain, but, on the contrary, was in a state of the greatest possible luxuriance; and I am certain I speak within compass, when I say I could have gathered hundreds of clusters of currants that would have weighed half-a-pound each. The stems of the bunches were so long and numerous in the clusters, and the currants so large, that I remarked to my children who were with me, I was convinced their appearance, so different from every other place at the same time, arose from the presence of salt in the atmosphere, occasioned by the boiling of so many pans at the salt-works here."

In addition to these facts, I am desirous of remarking, that the employment of common salt in agriculture and horticulture is much more frequent in foreign countries than it is in these kingdoms; for I have the most unquestionable authority for stating, that "salt is employed in the cultivation of the vine and other fruit-trees on the borders of the Rhone, and that they are improved by this application."

Most of the persons who have borne testimony to the bene-

ficial effects of common salt in horticulture, have observed, that salt has the property of attracting moisture from the atmosphere, and hence it is possible much of the important results may be derived. It is probably owing to the property which salt has of absorbing moisture, that it is customary, in bringing the cuttings of curious *vines from abroad*, to dip them in salt water before they are put on board. I have indeed been assured, that cuttings of the myrtle and other shrubs may be brought from a distance, with more certainty of their living, if they be previously dipped in a solution of common salt. Cuttings of the weeping-willow, the Salix Babylonica of Linnæus, which is a native of the East, could never be brought into this country alive, until the expedient of steeping them in salt water was adopted.

Requesting to be forgiven for these digressions, I shall conclude this branch of the subject in the words of a late venerable writer, who had probably made more experiments on the effects of common salt in horticulture, than any other individual in Great Britain. "Every thing," said he, "that is sown or planted in a garden or hot-house, should have a quantity of salt sown on the surface of the ground round it. By thus regularly forcing vegetation with salt, all the productions of the field and garden would be brought to maturity three weeks or a month sooner than they are by the present method of cultivation, as well as the various grains being much improved in weight and solidity, and the fruits in richness and flavour*." Sir John Sinclair, in quoting this passage, remarks, that "the advantage which is derived from the application of Dutch ashes, (so full of saline particles,) to the gardens in the Netherlands, is a full confirmation of this doctrine."

The SECOND property which I have assigned to common salt, when employed in the cultivation of a garden, is that of rendering esculent plants and fruit-trees unfit for the food or the habitation of worms and insects. Upon this, and the remaining branches of the subject, I must, however, be very con-

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* *Hints to Country Gentlemen, &c.* By John Hollingshead, Esq. Third Edition, p. 19.

cise, else I shall extend this paper to too great a length to be read at a single meeting of the Society.

The farmers who reside in the counties near the metropolis, and in several other districts in England, never put their seed-wheat into the ground until they have first steeped it in a very strong solution of common salt, as they find this to be a specific against the rust or blight in wheat, and that it prevents insects from preying upon the seed. As this practice is so efficacious in preserving seed-corn, why should it not be adopted with garden seeds, such as those of onions, carrots, turnips, radishes, celery, parsley, and the like?

The HONEY-DEW, which every year makes great havoc with fruit-trees, is, I believe, occasioned by small insects; and this may be entirely prevented from appearing by strewing the borders where the trees grow with common salt. Ants never appear in those parts of a garden where salt has been properly strewn; and how destructive these little animals are to trees, as well as to fruit, is well known. I have no doubt but that the fly in hops might also be prevented by the proper use of common salt.

Last year a gentleman called upon me from the Cape of Good Hope, to ask me if I could contrive any method of destroying an insect which attacks the vines in that colony, and produces incalculable mischief. He informed me that this is a peculiar insect, about the size of the millepedes, or common wood-louse, which creeps up the vines, and does so much mischief, that some plantations are rendered quite unproductive by it. Every crop would indeed be entirely destroyed, were it not that the proprietors of the estates keep a great number of women and children to pick off these vermin. These singular insects burrow very shallow in the ground in the day-time, say half an inch under the surface, and in the evening they come up upon the trees. The female slaves and their children go every night to the proprietor, carrying with them in their hats the produce of their industry, which he examines separately, and then empties it into a tub of water, which stands by him for the purpose. The slaves and children are then rewarded according to their

deserts, and the quantity of insects which each brings in, while the careless and indolent are proportionably punished. My informant assured me, that the ravages of these insects, the great number of hands that are required to destroy them, and the high price of labour at the Cape, have prevented the cultivation of vines, and the consequent improvement of the colony, more than any other circumstance. To extirpate these creatures, I advised salt to be spread upon the surface of the ground in which the vines are planted, and I am promised an account of the result of the experiment. Should I receive this, I shall not fail to communicate it.

It is not a mere speculation that common salt will prevent the ravages of worms and insects in gardens, for it has so often been tried by gardeners of experience, that no doubt can remain on the subject. More than fifty years ago, Mr. Thomas Hitt, who was gardener to Lord Robert Manners at Bloxholme in Lincolnshire, and afterwards to Lord Robert Bertie, at Chislehurst in Kent, published a very interesting work on *the Management of Fruit-Trees*, in which he gives a variety of directions for the use of common salt, founded upon the experience of many years' practice. This work is written with so much modesty, and is throughout so totally unassuming, that one feels inclined to receive his testimony without hesitation. The following brief extracts will, I trust, be interesting to the Society.

"I have," says he, "observed two sorts of CATERPILLARS feed upon fruit-trees, the one black, and the other green; the *black* generally make their appearance in March, if the season be dry, upon the pear-tree, apple, and several others. The green caterpillar, that feeds upon fruit-trees, for ought I know, may be the same as those that were black at their first appearance, but by green food their colour may be changed; but I have found them very prejudicial to both the young branches and fruit of the apricot, cherry, plum, apple, pear, currant, gooseberry, &c. When the caterpillars are first perceived upon wall or dwarf trees, I have prepared a brine, the same as for washing of walls at the time of pruning, and therein dipt a brush or besom, and swept the trees all over; this has destroyed

many by beating some off and killing others. This should be often repeated in dry seasons." Page 266—269.

On preserving fruit upon standard-trees from being destroyed by caterpillars, he remarks, that "as most noblemen have, at their seats, engines for extinguishing fires, which are very proper instruments for watering orchards, or such trees as cannot be reached with a brush; if orchard trees are watered all over with these engines two or three times a week, it will destroy many of the caterpillars. This should be done in the heat of the day, for then they hang the loosest upon the trees; and the water should be mixed with salt. This work is not only necessary when the trees are in blossom, but also before and after." Page 272.

"The HONEY-DEW," says he, "is a glutinous substance, very prejudicial to many kinds of fruit-trees, for it contracts the minute vessels of their most tender parts, and prevents their imbibing and perspiring such fluids as are required in vegetable life. A few days after the honey-dew appears, you may discover small insects on the underside of the leaves that are shrivelled, almost without motion; yet the heat of one fine day will make them visibly increase both in bulk and strength, and likewise in number." He adds, the honey-dew, "retards the motion of the sap at the extremity of the branches, and this prevents the fruit below from coming to any tolerable perfection, and damages the young branches to such a degree, that they are never after capable of bearing good fruit. Besides, many trees are entirely killed thereby, if proper methods are not used to prevent it. Though different kinds of SMOTHER-flies, or those of different colours, are found upon different sorts of trees, yet as they are all either bred from, or feed upon the honey-dew, all trees require the same care and management, to preserve them from these evils; for no tree prospers well when either the honey-dew or smother-flies are on the extremities of its branches."

The remedy which he proposes for these evils is nothing more than common salt, administered in the following manner: "If the season be wet, spread common salt all over the border,

about eight ounces to each tree; for the more salts the juices contain which form the young branches, the more compact and smooth their leaves will be, and thereby less subject to the penetration of the honey-dews. If trees are thus ordered at all times, when the honey-dew appears on them, neither it nor the flies can ever do them much injury." The foregoing paragraphs are taken from the chapter directing how to treat trees in *new* borders. In that "of the honey-dews and smother-flies on fruit-trees growing in *old* borders," he has the following remarks: "If the borders be impoverished, by having either too much kitchen-stuff or flowers growing upon them, the trees will be too weak; and if the weather be dry, they must be watered plentifully three times a week, with one ounce of salt added to each gallon of water. If the fly be strong, double the quantity of salt, and water the bottom of every tree before the soot or lime is laid on at the time of trenching; but if there is not an opportunity of trenching, nevertheless water thus mixed (with salt,) must always be used for the above purpose."

"I have found these methods successful, even when the flies have been very strong upon the trees, and have in a few days destroyed many of them, and caused the trees to shoot vigorously." In obstinate cases, he directs to dissolve two ounces of salt in a gallon of water, and with this mixture to brush the trees all over, beginning at the bottom of the tree, and making all the strokes upwards. This, he says, will cause all the infected leaves to drop off the trees, but will not injure the healthful ones, but occasion the trees to make good shoots after, even such as will produce fruit the next year on peaches and nectarines." Pages 279—281.

On the destruction of fruits by ANTS, this interesting author gives the following important directions: "The ants," says he, "are much complained of for destroying fruit and leaves; but when borders are rightly prepared and ordered they cannot live; nor in old borders, after they have been trenched and watered with the composition mentioned for that purpose. Against old walls, either of brick or stone, they are the most troublesome, for as they lodge in the nail-holes, the watering of the borders

only has no effect upon them: but the *walls* should be watered all over with brine, made by adding two ounces of salt to a gallon of water." Page 282.

During a journey in the summer and autumn of last year, through the north of England, and part of Scotland, I heard repeated complaints of the failure of the onion crops, which were said to be destroyed by the wire-worm. This was more particularly the case around Edinburgh, and throughout the county of Fife. Letters from home also informed me, that in the neighbourhood of London onions were so scarce for a month or two, from the same cause, until foreign onions were obtained, that they were sold in Covent Garden market nearly as dear as peaches. It gave me, therefore, much pleasure, happening to be at Edinburgh at the Anniversary Meeting of our Society, to hear the communication from Mr. Morton, a gardener in the neighbourhood of Dunbar, who informed us by a letter, directed to the Secretary, that he had preserved his crop by the use of salt water, while those in the gardens around him were all destroyed.

Thirdly, common salt is not only a preservative of plants and trees from the ravages of grubs, worms, and insects, but it is one of the most effectual substances that can be employed in a garden for the destruction of these animals themselves. Of the truth of this assertion any one may satisfy himself in a very short time by direct experiment. If a small quantity of salt be sprinkled upon a common earth worm, its destructive effects will be seen to be almost immediate. Its action on worms is also very strikingly exemplified by its effect on the hirudo, or common leech. When this creature has been employed in supplying the place of the lancet, it is usual to put a small quantity of salt upon it, so as to touch its mouth; this occasions the leech instantly to disgorge all the blood into the plate on which it is laid, but if too much salt be used, or if the leech remain in contact with it too long a time, the salt is apt to prove fatal: hence some of the people who bleed with leeches, prefer taking the blood from them by pressure, rather than risk the loss of them by using salt. The Right Honour-

able Sir John Sinclair, in a valuable paper which he has lately published, thus explains the operation of the salt. "Salt," says he, "destroys vermin in the ground, by making them void the contents of their bodies, such evacuations being too powerful for them to withstand. It has," he adds, "this additional advantage, that the vermin thus become food for those very plants which otherwise they would have destroyed."

The eminent John Evelyn, the celebrated author of *Sylva* and other interesting works, and who himself was very zealous in the improvement of the art of horticulture, had learned the effect of common salt in destroying slugs, worms, and other creeping vermin, as appears from a paper in the first volume of the *Practical Husbandman and Planter*, 8vo. 1733, page 58; but it does not appear that he had regularly employed it for that purpose.

From an *Essay on Plantership*, published by Mr. Samuel Martin of the Island of Antigua, it appears that common salt has been employed in the West India Islands for the destruction of grubs and insects. "Soils," says he, "which are subject to the grub, and must be fertilized by common dung, which is a proper nest for the mother beetle to deposit its eggs, should be well impregnated with the brine of dissolved salt, after the dung is first cut up; two large hogsheads of salt will make brine enough for a dung-pan of fifty feet square. This cure for the grub is a late discovery, for which I am obliged to a judicious planter, and which I have tried with success."

"A land-surveyor of high character in my neighbourhood," says the Right Honourable Lord Kenyon, in his evidence delivered before the Board of Trade, "considers that the use of salt would be likely to be very valuable in destroying the slug, wire-worm, snail, &c., which often destroy even whole crops. He also well remembers that salt was used largely in the neighbourhood of the higher and lower Wiches in Cheshire, before the duties were raised to their present height."

This is confirmed by a writer in Dr. Rees' Cyclopedia, under the article "Salt," who says that "in Cheshire and other counties, they make a great use of the water of their salt springs

as a manure for their lands." He adds, "They let out the water of these springs for a certain time upon the lands, after there has been rain, and by this means the quantity of salt they contain is so blended with the rain water, that it is too weak to hurt the corn or grass, and yet strong enough to kill worms and other vermin, and to improve vegetation."

The FOURTH property which I have assigned to common salt, when employed in horticulture, is that of destroying weeds and other noxious vegetables. On this part of the subject the evidence is not so abundant as I could have wished; the following testimonies however do, I think, deserve attention.

The author of an essay on the effect of salt on vegetation, published in the first volume of the *Practical Husbandman*, before quoted, expresses himself thus: "I am well assured from a Scotch gentleman, that they have long used salt in that part of Great Britain, always sowing ten or twelve bushels by hand of their coarse salt, on an acre of young green wheat, some time in November, December, January or February; it being, from the several accounts which I have had of it, very effectual in the killing of tender weeds amongst corn, yet at the same time cherishing the corn, and adds much to the goodness and plumpness of the grain." Page 48.

Bishop Watson, in his *Chemical Essays*, says, that "in Cheshire, wherever the soil abounds with rushes and weeds it is customary to lay a quantity of rock-salt upon it to destroy them." Vol. ii. p. 73.

Gervase Markham, the well-known writer on rural affairs in the middle of the seventeenth century, strongly recommends the use of salt as a manure for land, in his book entitled "*A Farewell to Husbandry*," and concludes his observations by remarking, that "there is nothing which killeth weeds and other offences of the ground so much as saltness."

Major John Taubman, speaker of the House of Keys in the Isle of Man, in giving his evidence before the Board of Trade, in the year 1817, states, that "he has used refuse salt as a manure on meadows, with advantage; it was sown thinly by hand,—cannot speak to the quantity used; the meadow had

been much covered with moss, which the dressing of salt entirely destroyed."

"Mr. Sickler made a little heap of earth in the midst of a field, on the top of which a cart-load of refuse salt was thrown; the earth in the heap itself, and, after its removal, the earth under it for upwards of two feet deep, to the clay was rendered so perfectly barren, that the most common weeds would not vegetate in it. This barren earth, however, furnished the richest dressing for the remainder of the field*."

I have now laid before you all the evidence which I have been able to obtain on this part of the general question,—the use of sea-salt in horticulture. I am, however, fully sensible that, although enough may have already been proved for us to form the decision, that the use of salt in gardening is essential, there are probably many well established facts which have not yet come to my knowledge, and from what we have already attained, we may presume that our information on the subject is yet very limited.

To employ this very valuable mineral substance in the best possible way, much is to be acquired by practical knowledge, by direct experiment, and by vigilant observation. Every distinct vegetable, whether in the state of seed, root, or more mature growth, from the plant to the largest fruit-tree, may possibly have its distinct habitude and peculiarity. Some may require more, others less; some may admit of an immediate application, while others require the salt to be laid on at a little distance. In short, it is obvious that, since the general benefit of the practice which I have endeavoured to impress upon your notice has been substantiated by experience, we have now nothing more to follow than experimental researches.

As a manure for land, sea salt is considered of so much importance by the Board of Agriculture in London, and by the Highland Society of Scotland, that both these associated bodies have offered premiums for experiments on the subject. The offer from the Board of Agriculture is announced thus: "To the person who shall make and report to the Board, the most

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* *Case of the Salt Duties*, by Sir Thomas Bernard, Bart., page 275.

satisfactory experiments to ascertain the advantages or disadvantages which have attended the use of salt as a manure, either simple or mixed with other substances;—The gold medal or fifty pounds. Accounts to be produced on or before the 1st of March, 1820." The Board adds: "It is to be hoped that this premium will excite a laudable spirit among enterprising farmers, to ascertain particulars of such importance to the agricultural interest."

The reward held out by the Highland Society of Scotland is, "To the person in Scotland who shall make and report to the Society the best and most satisfactory experiments on the effects of salt as a manure in general,—A piece of plate of thirty guineas value, or that sum in money. The reports to be lodged with the Deputy-Secretary on or before the 10th of November, 1820."

From the interest which I have long taken in this subject, and the share I have had in obtaining the late act of parliament, for lowering the duty upon rock-salt for the purposes of husbandry, I felt much pleasure and satisfaction on seeing these premiums announced to the public; and I am inclined to hope that the late concession of the Legislature will prove the forerunner of a total repeal of all the existing laws relating to salt, and that the offer of these premiums will occasion such a spirit of emulation among the farmers, as must conduce, in an eminent degree, to promote the improvement of agriculture. Greatly do I wish that the Horticultural Societies of London and Edinburgh may attach a proportionate degree of importance to the employment of common salt in their experimental researches, and thence be induced to offer such premiums as cannot fail to stimulate the exertion and attention of all our rational and scientific gardeners, so as to lead their inquiries towards the investigation of this very interesting and curious subject. Should the foregoing collection of facts have the least tendency to invite the Council of the Caledonian Horticultural Society to institute such a prize, I shall derive considerable satisfaction from the circumstance of having suggested a measure so important, in every point of view, to a great majority of persons, of all classes, in the British dominions.

Art. VI. *On the Origin of the Ashantees, and Inhabitants of the Gold Coast of Africa.* *By* J. F. Bowdich, Esq. *Communicated by the Author.*

The advance towards civilization and the arts, and the numerous exceptions to the negro physiognomy, which astonished me on penetrating to Ashantee, when associated with the striking similitude of most of their superstitions, laws, and manners, to those of the Egyptians, naturally excited interesting speculations, and induced me to use my earliest leisure in consulting those classical authors upon such subjects, whose descriptions my memory could but imperfectly recall.

The traditions of emigration, not of the whole population, but of particular families, so current in Ashantee, and the neighbouring nations, persuade me that they are native Ethiopians, mixed with settlers from ancient Egypt, as the Abyssinians have been recently shewn to be, with the strongest probability, in opposition to a former opinion, of their Arabian descent.

I will not dwell on the subjugation of Ethiopia by Sesostris, but rest principally on the fact mentioned by Herodotus, that 130 years before his time, 240,000 Egyptians emigrated, or rather fled from Psammiticus, and went as far beyond Meroe, as Meroe is beyond Elephantine, or a journey of four months from the latter country. That they presented themselves to the king of that part of Ethiopia, who gave them the lands of some of his enemies, whom they ejected, and that the Ethiopians civilized themselves in adopting the manners of these Egyptians.

The Ethiopians, thus dispossessed by the Egyptians, were doubtless only pressed or removed into the nearest convenient country, and still preserving an intercourse, participated in some degree in the civilization introduced by the emigrants from Egypt. The sweeping expedition of Ptolemy Evergetes, who, by the record of his triumphal monument at Adulis, is known to have subdued nations southward of the sources of the Nile, and others as far eastward, as we presume the present kingdom of Kulla to be, no doubt compelled many Ethiopian tribes or families, inheriting the opinions and customs their

ancestors had adopted from the Egyptian emigration, to retire still more westward, from the first alarm of his approach, the the fear of a second invasion, or the apprehension of being spoiled of the half of their possessions, as he records some of the nations he subdued, to have been. We are to recollect also, that the Egyptians had colonies at Tachompso, Meroe, and Gojam; that Ptolemy Philadelphus penetrated, with 500 horse, into the country of the Ethiopians, and founded the city Ptolemais Theron.

Herodotus and Diodorus Siculus, both agree in distinguishing the Ethiopians in some degree civilized, from others who were savages; speaking of the former as having been of themselves a little advanced, and afterwards perfected, in laws and manners by the deserters and colonists from Egypt.

Both authors impress that the genuine laws and customs of these Ethiopians (preserved distinctly from those they had received from the Egyptians,) were very singular, especially as regarded the succession or royalty. It will be seen that such laws and customs of Ashantee, as cannot be assimilated with the Egyptian, are of a very original and extraordinary character, and especially as regards royalty or the succession.

Diodorus says of the Ethiopian savages, that some deposit their dead bodies in the water as the most honourable sepulture, and others in their own houses. Now it is remarkable, that the Jum Jums, spoken of to Mr. Hutchison, as a cannibal nation, adjoining the Niger, far to the eastward, were particularly described as consigning their dead to the river in rude coffins. The Sheekans and Kaylees, and other Anthropophagi, whom I have mentioned and laid down for the first time in the map of Africa, having conversed with individuals of these nations, in the Empoöngwa, or Gabon country, bury their dead in their houses under the beds. It will be seen too in my chapter on Geography, that the Jum Jums of Mr. Hutchison, as laid down in a manuscript Arabic chart which he sent to me; the Yem Yems, the cannibals described to Mr. Horneman as south of Cano, and the Niger; the cannibal nations, behind the river Gabon, (who eat their dead, even their own children,

or expose them for sale the moment the breath is out of their bodies,) all occur on these different authorities in the same neighbourhood, if not in the same spot.

There can be no doubt then, that these nations, found almost precisely where Ptolemy has placed his Ethiopes Anthropophagi, are the descendants of the savage Ethiopians of Herodotus.

Having thus separated or disposed of the barbarous Ethiopians, by identifying them with the cannibal nations, still retaining such of their customs as are briefly recorded, and found in the same geographical situation, I will return to the Ashantees, whom I have considered to be the civilized Ethiopians of Herodotus and Diodorus, pressed westward by the Egyptian emigrants, (by an intercourse, with whom they nevertheless acquired the arts, manners, and superstitions, which now astonish us,) and afterwards driven, or emigrating still further westward, by the sweeping expedition of Ptolemy Evergetes.

The Ashantees, and their inland neighbours, must have again been disturbed from time to time by the several emigrations of the Carthaginians, and other nations of the Mediterranean, whom Mr. Buache, in his researches for the construction of a map of Africa, for Ptolemy, has at once discovered, by the identity of the names, in the neighbourhood of the Mediterranean and south of the Niger. The Mimaces, for instance, are laid down by Ptolemy, a little south of Tripoli, and again a little west of the modern Yarriba. The Nabatræ, close behind Algiers, and also where Dahomey now exists. The Dolopes, in the present dominion of Tripoli, and again, where we expect to find the negro kingdom of Kulla. The Blemmyi we find in three places, on the Arabian Gulf; near Rees Ageeg, on the eastern frontier of Abyssinia; and south of the line, a little above the track of the traders from Loango to Nimeamay. Many other instances might be adduced of the same names being found at remote distances north and south of the Niger, whilst other nations, as the Samamicii, on the shore of the Mediterranean, near Lebida, do not appear in Ptolemy's time

to have reached the Niger, but to have rested in their progress on the northern frontier of the negro kingdom of Asbex.

As late even as the present time, I found a kingdom, called Takima, on the northern frontier of Ashantee, and another called Tahkema, was laid down by the Moors (who furnished me with the MSS. charts,) between Timbuctoo and Fezzan. The Fantees have still a tradition of their coming from Takima. The expedition of Cornelius Balbus (the last Roman general who had the honour of a triumph,) who reached the Niger, and marched for some time on its northern bank, (apparently where the modern negro kingdoms of Noofee, Yaoora, and Fillani, are now situated,) must doubtless have disturbed many of the colonies and aborigines, and induced movements to the south of the Niger. The previous expedition of Suetonius Paulinus, (who seems to have passed near where Park understood the source of the Niger to be, into the country of the Perorsi, who are placed by Ptolemy between the Gambia and the coast,) must have also contributed to these secondary movements of the Ethiopians. M. La Traille, of the Institute of France, did me the honour to read to me his objections to the alleged extent of this expedition, in a MS. he is about to publish; but I have since been informed by Major Rennell, that it appears from the artless and consistent narrative of Scott, the *English* sailor, (who was, undoubtedly, in Major Rennell's opinion, carried across the lake Dibbir, and whose narrative is about to be published,) that the Sahara, instead of being a continued ocean of sand, is crossed by a belt of firm land, equal to nearly two-thirds of the whole extent. This materially diminishes the difficulties M. La Traille has ingeniously opposed to the expedition of Suetonius Paulinus.

Some may prefer the opinion, that a part of the numerous emigrants and deserters from Egypt, may have penetrated as far westward as Ashantee, as it will explain the coincidence of manners and superstitions equally well; but the identity of many of their more extraordinary customs with those of the Abyssinians, and their own traditions of emigration, incline me to believe that they were once nearer each other.

It appears too, that the Arabs whom Pliny, King Juba, and other ancient writers, affirmed to have settled from Syene as far up as Meroe, have since that time penetrated south-westward into the interior of Ethiopia; for in the accounts and the MS. charts, which I received from the natives, Wadey was always distinguished as the first Arab dominion, and that people were said to use a different diet, and their ambition only to be repressed by the great power of the Emperor of Bournou. This progress of the Arabs inland, must also have contributed to the dislocation of the Ethiopic or negro nations.

The few extraordinary superstitions, which cannot be assimilated to the Egyptians, may be considered for the most part as pure Ethiopic, as is, probably, their original and poetical tradition of the Creation.

That the Ashantee customs may have again been a little diversified by intercourse with the Carthaginian colonies, which settled south of the Niger, appears probable from some habits I have recorded, particularly that of spilling a little liquor on the ground as an offering to the Fetish or Deity, not only in their sacrifices, as we read in the Greek and Roman writers, but invariably on common occasions, a domestic custom which Homer also attributes to the Trojans.

The Phœnicians confessedly made human sacrifices, and "frequently even of those who were most dear to them," although these sacrifices were early discontinued, as well as in Egypt, without our being told why. The Phœnician priests were in the habit of cutting their bodies with knives and lancets; those who pretend to sudden inspiration, (or that the Fetish has come upon them,) in Ashantee, lacerate themselves dreadfully by rolling over the sharp points of rocks, beating themselves, and tearing their flesh with their own hands, so as to present the most shocking spectacles. The Phœnician priests also worked themselves to the height of frenzy by dancing, and the violent exercise of their voices, and then raved or prophesied, as if possessed by some irresistible power. I have frequently seen the Fetish women or priestesses in Ashantee, (and I think I was told that the priests did so too,) dancing or

whirling round on one leg until they became stupified from giddiness, yelling and screaming the whole time, and then uttering what was called the voice of the Fetish.

The Ashantees, however, will be found to retain the Egyptian superstitions, laws, and customs, much more perfectly than the Abyssinians; because the latter must have abandoned many on their conversion, as incompatible with their new religion.

First, then, I shall shew wherein the superstitions, laws, and customs, of the Abyssinians and Ashantees still agree; and, secondly, submit the identity of those wherein they do not still agree, with those of the Egyptians, as described by Herodotus and Diodorus.

The following customs will be recognised as Abyssinian. The King of Ashantee is never to be presumed to speak but through his ministers or interpreters, who invariably repeat even his simplest observations, however audible beforehand. He confines himself to the palace, and is invisible to his subjects for several days, twice every six weeks. Before decision in criminal cases he always retires to a secret council. His domestic officers and menial slaves live in a state of familiarity with him unknown to the rest of his subjects. He never eats in public, or before any but his slaves. It is high treason to sit on the king's seat, which is turned upside down the instant he quits it. He distributes gold chains, swords, and bracelets, as the rewards of great actions.

In Abyssinia none inherit the throne with any bodily defect. In Ashantee the most lawless intrigue is permitted to the females of the royal family if their gallants are handsome, with the view of securing the same pre-eminence of person to the heirs of the throne.

The throne of Ashantee is hereditary in one family as in Abyssinia; and I cannot but consider the prefix of Sai or *Zai*, (for it was pronounced both ways, and at first I always wrote it with a z,) to the names of all their kings as extraordinary, when I read the following remark on a list of the ancient kings of Abyssinia, by Mr. Salt. "Up to this time, we find *Za* or *Zo* prefixed, which is the mark, I conceive, of the shepherd kings, or ori-

ginal Ethiopians; but about this time the El which succeeds, seems to denote a change in the dynasty, probably by a colony of Syrians placed by Alexander to the south of the Axomites near the mouth of the Red Sea." The people of a country called *Zaa*, were recorded in the inscription at Adulis, as one of the Ethiopian nations subdued in the expedition of Ptolemy Evergetes. *Z*erah was the name of the Ethiopian king whom the Chronicles mention to have invaded Judah.

Another very extraordinary coincidence is, that the king of Ashantee has, as part of his state household, a band of royal or licensed robbers, organized in the same manner as those who annoyed the earliest European visitors to the capital of Abyssinia, and who there also were attached to the royal household.

The kings of Abyssinia in their expeditions are always attended by judges or civil authorities; no Ashantee army ever proceeds on a campaign without one being attached to it, and if the king is present, three or four.

The Abyssinians, like the ancient Egyptians, never fight in the night; neither do the Ashantees, not even after sun-set, whatever advantages they may lose. In general, execution immediately follows sentence in both countries, and the bodies of those who have been executed for treason or great offences, are also, in both countries, left exposed, even in the streets, to the wild beasts.

There is no such thing as marriage in Abyssinia but by mutual consent, subsisting only until dissolved by the wish of either party. So in Ashantee, the mere return of the marriage present to the husband, by the wife's family, on her dissatisfaction, dissolves the contract. There was a law in Babylon *precisely* the same as this.

Circumcision is arbitrary in Abyssinia, and it is rarely practised in Ashantee; but in Dagwumba, and other of their more eastern neighbours, who seem to possess a still superior degree of civilization, it is general.

I think we shall discover that Josephus was right in placing Sheba in Africa, for Mr. Salt mentions, that the Abyssinians have a tradition from Ham, that one of their queens named

Magueda, who was queen of the south, visited Solomon, by whom she had a son named Menelich. This tradition, with additional circumstances, seems to have reached Mr. Hutchison in Ashantee, who writes in his diary, " Balkis, (Queen of Sheba,) according to them, adored the sun, and Solomon made her turn and worship God; he commanded the genii to transport her palace from her own country to Jerusalem, and the three palaces he built for her in Arabia Felix, had gold mixed with the mortar with which they were formed." Mr. Hutchison naturally concluded the country of this queen to be in Arabia Felix, because it has hitherto been so placed by the greater number of opinions. Arabia Felix was not mentioned to him by the Negro Moors I am positive, I even question if Sheba was, though in his mind there could not be the least doubt that these countries were alluded to. If ever I have the pleasure of seeing Mr. Hutchison again, which I hope I shall, I shall inquire particularly as to this tradition, which is the more curious, as it asserts, that " the queen turned from worshipping the sun and worshipped God," which, though not directly stated, may be expected as a result from her exclamation, (2 Chron. ix. 8.) and from the observation of Stackhouse: " Accordingly it was Solomon's fame concerning the name of the Lord, that is, concerning his knowledge of the Supreme Being, and the proper manner of worshipping him, which excited her to take so long a journey. And therefore our Saviour says, " that as she came so far to hear his wisdom, (his wisdom concerning the nature and worship of Almighty God.) Matt. xii. 42., she would, at the day of judgment, rise up against that generation which had refused to listen to him." We have thus traced the close resemblance, and in many cases the identity of the customs of the Abyssinians and those of the Ashantees, so that the latter are as evidently descendants from the civilized Ethiopians of Herodotus as the former, especially as the two or three particulars which he and Diodorus afford of the customs of the savage Ethiopians, are not to be traced at all in Ashantee, but are actually identified amongst the Sheekans, Jum Jums, and the existing or modern Anthropophagi of Ethiopia.

I will now shew that the Ashantees seem to have preserved the superstitions, manners, and arts, which the Egyptian colonists and visitors introduced amongst them, much more tenaciously than the Abyssinians.

The vitrified beads which they dig up frequently with sepulchral gold, and which (having lost the art of making them,) they insist to be natural productions *; the rude outline of the Ibis, so frequent, and the only figure of an animal to be seen in their buildings; their curious pottery, and the marked Egyptian character of most of the ornaments of their florid architecture, would show an intercourse with Egypt, even if their existing superstitions and customs did not confirm it.

In Ashantee, as in Egypt, the women generally sit in the markets, and the men always weave; they are constant to their ancient music; the two sexes bewail the death of a friend or relative, parading the streets in troops: false accusers are punished as the accused would have been if convicted: the king has the actions of his ancestors and eminent men recounted to him by the elders on his rising in the morning, as the scribes read them to the Egyptian monarch for imitation out of the sacred records: they do not eat with strangers; besides many other coincidences auxiliary to the opinion of their former connexion with Egypt, though not so conclusive as the identity of superstitions and customs strikingly original and extraordinary, not common to the infancy of mankind, but more peculiar to the two nations, which I proceed to submit.

Herodotus says, the Egyptians eat in the streets, but for the other needs of nature they seclude themselves in their houses. It is common in Ashantee to eat in the streets, but the passage accounts for one of the most surprising of their superiorities, namely, the Cloacæ, in the retired parts of the houses of the higher class, even in the upper stories, and to the construction, and cleanliness of which, they pay so much attention.

* These beads, however, may as probably be Phœnician, from so many of their descendants being found at once on the Mediterranean, and South of the Niger.

Human sacrifices were practised by the ancient Egyptians. Men were sacrificed at Heliopolis, and to Juno or Lucina, at a city in the upper Thebais, called by the name of that goddess.

Herodotus writes, "In other nations, when in grief, they shave their heads, especially the near relatives; whereas in Egypt these persons allow their beard and hair to grow on such occasions." The present king of Ashantee had not his head shaved, or his beard cut for twelve moons after the death of his brother Sai Quamina, according to the custom of the country.

Herodotus speaking of the Egyptians embalming dead bodies, adds, that the Ethiopians do so too, but in a different manner; the Ashantees smoke them for preservation.

The priests in Ashantee as in Egypt, enjoy a portion of the offerings. When the king sends his frequent offering of ten ounces of gold to the various deities, the distinct priests are allowed to take half. The dignity of priesthood also is hereditary; they are exempt from taxes, and they do not pretend to divine of themselves, but merely to utter the will or disclosures of the Deity: the same is recorded of the Egyptian priests.

White is a colour as sacred in Ashantee as it was in Egypt; the priests are not only distinguished by white clothes, but they even chalk their bodies all over. The king and all men of respectability put on white clothes on their Fetish day, or Sunday. The acquitted are always chalked by the king's linguists, as a mark of their innocence; and the king always swears, and makes others swear on a white fowl.

In Egypt each month and each day was sacred to some god; in Ashantee, they have good and bad days, and good and bad months, and all undertakings are regulated accordingly.

Crocodiles were sacred in Egypt, and fed with flesh. In Ashantee the sacred crocodiles generally called alligators, (but which as yet are only known in America,) are fed with white fowls, by the fetishmen or priests. Diodorus mentions wolves as sacred in Egypt. Hyænas are called wolves at the Cape of Good Hope; and they are sacred amongst the neighbours of the Ashantees. Clement of Alexandria makes hyænas for-

bidden food according to Moses. In Egypt to kill a sacred animal designedly, was death; accidentally, a fine to the priests; such is the custom in these countries also, and the *head* of the hyæna is wrapped in white cloth, and buried, which is curious when we recollect, that the Egyptians never *eat* the head of an animal, and that the sacred animals had funerals. The vulture (though it does not appear to be the Percnopterus,) is sacred in Ashantee for the same reason as it was in Egypt, because it consumes all the offal of the neighbourhood. Juno also was worshipped under the form of a vulture in the upper Thebais.

In Ashantee some families do not eat mutton, some abstain from fowl, others from goats' flesh, others from beef. We read in the accounts of Egypt, "And the shepherds lived upon cows' flesh, which made them a separate people." Herodotus says also, that some of the Egyptians did not eat beef, others did not eat mutton, others spared goats. Mr. Bruce observed, that some of the Abyssinians would not eat fowl, others never touched veal. Mr. Hutchison observes in his diary, (p. 412.) "Thus many of them are so particular they will not stay where eggs are, another shuns a fowl, ones hates beef, and many mutter a charm if they meet a pig." Pigs were abhorred in Egypt, and many avoided all connexion with those who tended that animal.

Diodorus is particularly struck with the peculiarity of the Egyptian custom, "that those who wish to exercise the calling of thieves, are secretly registered by the superior of the fraternity, to whom they carry all their spoil; so that on the losers' going to him, and particularizing their property, they receive it again, on paying one quarter of the value." The following passage is from my chapter on the superstitions of Ashantee. "The inferior class of priests pursue their various occupations in society, assist in customs and superstitious ceremonies, and are applied to as fortune-tellers or conjurors are in Europe, especially in cases of theft, when from a secret system of espionage, and a reluctance frequently amounting to a refusal to discover the culprit, or to do more than replace the property whence it was taken, they are generally successful."

Diodorus has certainly disclosed the secret of these transactions, the existence of which affords a curious argument.

I have dwelt (in the chapter on the History of the Ashantees,) on the distinction of the bush-cat, dog, buffalo, and tiger families in Ashantee and the neighbouring states, and considered the curious circumstance of individuals of different nations arranging themselves in the same families. Herodotus tells us, that in Egypt a certain number of men and women were destined to take care of particular animals, and that the son succeeded to the father in that duty. Cats and dogs were sacred in Egypt, and accordingly we find the relics of this curious institution still existing in modern Ethiopia, and that the Egyptian colonists and deserters introduced a custom, every trace of which was lost, until these recent inquiries. The "Corn-stalk" and "Red-earth" families were, probably, originally Ethiopian, for Diodorus says, some were agriculturists, and some shepherds. I had an opportunity of perusing the researches of Meinars, but I cannot help thinking, that as we prosecute our acquaintance with the natives of the interior of Africa, we shall find additional grounds to dissent from his opinion,—that there is a greater conformity in customs and political institutions between the Egyptians and Hindoos, than between the Egyptians and Ethiopians.

The parias of India have been compared with the swineherds of Egypt; and the appiadee, or servant race of Ashantee, corresponds with both. The Ashantees observe the oriental custom of using the left hand only for all ignoble purposes, and of cooking and eating with the right.

The Ashantees cherish their beards and 'swear by them' as the eastern nations do, contrary to the impression of Strabo and Meinars, that the neglect or want of a beard was one of the few differences between the ancient and modern Ethiopians and the Egyptians. The three classes of men in ancient Egypt are to be recognised in Ashantee; and Meiners' description of the *milites nobiliores* as a rank not attainable by merit or achievement but by birth alone, and as individuals sharing the territory with the king, agrees precisely with the institution of

the aristocracy in Ashantee, who until Sai Cudjo's time, always gained this dignity by inheritance only, could never forfeit their lives, and even now continue to share the territory and the power with the king.

I do not recollect to have ascertained that the Ashantees retained the remarkable antipathy to beans of the ancient Egyptians, but I think it probable, for it is extraordinary that when they were assuring me there was really an Arab nation in the interior, they always distinguished them as "*eating beans.*"

There are many remarkable coincidences of the customs of the Ashantees with those of the Jews. The *British Critic* thus notices one in my work, which had not occurred to me. "About ten days after the Yam custom, a sheep and a goat are sacrificed in the palace in the afternoon, and the blood is poured over the door-posts. It is scarcely possible but that this rite must be connected with some obscure tradition of the Jewish passover." The Jews too, it well be found, (whether they learned it or introduced it in Egypt,) observed the same peculiar delicacy which Herodotus records of the Egyptians, and which has originated in the cloacæ of the Ashantees, a refinement almost unknown in many European countries *. The Jewish priests received a part of the sacred offerings †. The Jews did not trim their beards when in grief ‡. There is a servant race or family in Ashantee. The Ashantees will not touch milk: Mr. Hutchison mentions an anecdote in proof of this observation. "A boy brought some milk covered, and Apokoo lifted the lid to look what it was, some of it touched his fingers, and he sent for water, herbs, and different things to purify his fingers; he said he would give me a present if I would give over drinking milk; I told him if he sent me an ounce of gold daily I would not do it; he cursed the milk, and the boy for bringing it." The strict Jews do not eat cheese, unaccountably founding their abhorrence, as I have been told, on the command in Exodus, "Thou shalt not seethe

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* See Deut. xxiii. 12, 13, 14.

† Levit. xxxi. ‡ 2 Sam. xix. 24.

a kid in his mother's *milk.*" Strabo speaks of Jewish colonies in Egypt.

Thus we discover, that Abyssinia is not the only country which has been partly civilized by colonies from Egypt, and that much light may be reflected on history as well as the physical sciences, by pursuing our discoveries in Africa gradually and in detail.

Should we reach Dagwumba, the seat of their great oracle, and the repository of their rude learning, and traditions, MSS. may be collected; many other interesting é claircissements of Ethiopian history may result; literature as well as science may be benefited; we may add historical to the osteological proofs of Cuvier, that no race of negroes produced that great people who gave birth to the civilization of ancient Egypt; and we may discover, that the civilized Ethiopians, not only from their intercourse with Egypt, but abstractedly, were a much more interesting people than even Herodotus expected.

J. Edward Bowdich.

Art. VII. *An Account of an extraordinary Biliary Calculus. Transmitted to the Editor by* Sir E. Home, Bart., F.R.S., *&c. &c.*

Dear Sir,

Having received the biliary calculus and the accompanying case from a friend in the country, they appear to me to create considerable interest, and not undeserving a place in your Journal. Your inserting them will much oblige,

W. T. Brande, Esq.,
Royal Institution.

Yours, most truly,
Everard Home.

Mrs. G., resident at East-Bourne, aged about 45, had been all her life at times subject to bilious attacks, attended by their usual symptoms, but she never had complete jaundice. Upon some occasions the bilious symptoms were attended with a distressing itching over the whole surface of the body. Within the last two

years she had frequently suffered pain in the region of the stomach, especially after eating.

On Friday, the 28th of July, 1820, having been wearied by a walk, she threw herself upon a sofa, and instantly screamed from pain high up in the abdomen, which left her in a few minutes. On Saturday evening, the 29th, she was again seized with a similar attack, which was frequently repeated; five grains of calomel and half an ounce of sulphate of magnesia were administered, and afterwards she had several hours' sleep. There was no tension, and the pain was but slightly increased on pressure; the pulse, however, had become very quick. On Sunday morning, the 30th, there was considerable fever, the pulse was beating 130 in a minute, but not hard; the bowels had scarcely been affected; twelve ounces of blood were now taken from the arm, which moderated the pulse for a time, but costiveness continued, and nothing would remain upon the stomach. In this state she continued during the day, when it was deemed necessary, in consequence of the pulse returning to its former frequency, to repeat the bleeding, which was done to the amount of twelve ounces at five in the afternoon.

On Monday the 31st the pulse again quickened; there was much restlessness, sickness, and want of due evacuation from the bowels, though the calomel and salts had been repeated. It was therefore thought necessary to bleed a third time to the extent of fourteen ounces; pills of aloes, jalap, and calomel were used at intervals, with the salts, and during the night and on the morning of the first of August, the bowels began to be scantily affected with manifest relief of pain.

Tuesday, Aug. 1. The pulse came down to 84; the bowels continued sparingly active, and the stomach rejected gruel and broth which were repeatedly taken in small quantities at a time.

Wednesday, Aug. 2. The symptoms remained as yesterday, without increase of pain; the sickness continued; but two doses of Epsom salt, of three drachms each, remained upon the stomach.

On Thursday the third of August, the aperient medicines were more effective than they had previously been during her

illness, and at seven in the morning the gallstone, represented in Plate I. fig. 1, was passed.

Friday, Aug. 4. The uneasiness and pain of the bowels had entirely disappeared. She slept well during the night; the pulse was about 80, and light food remained upon the stomach.

Saturday, Aug. 5. Late last night and early this morning, the pain returned nearly as violent as before, the pulse became again 130 and 140 in a minute, the tongue very white, and drowsiness alternating with delirium came on towards the evening, but there was no vomiting, nor was the abdomen either painful or tense. Under these circumstances it was deemed advisable again to have recourse to the lancet, and eight ounces of blood were withdrawn; the calomel and Epsom salts were repeated, which fortunately remained on the stomach, and soon occasioned an abundant evacuation, after which the alarming symptoms quickly decreased and every thing continued to do well. The amendment has been progressive up to the present time, (August 26.) The last attack appeared to have been caused by the irritation occasioned in the bowels by eating a quantity of currants.

The shape of the gall-stone, as shown in the Plate, is nearl cylindrical, with a tubercle projecting from its side; its length two inches, its diameter three-fourths of an inch; it weighed 239 grains. One extremity was apparently broken, and two or three fragments were voided along with it. The broken end exhibits the appearance of concentric layers, the colour of the exterior layers being rusty brown, while the central portion is pale brown, and in parts nearly white.

This account is drawn up from a memorandum of the case transmitted by Dr. Blair of Brighton, and from a letter from a gentleman in whose family it occurred.

The gall-stone is almost entirely composed of the spermaceti-like substance which M. Thenard has called *cholesterine;* it is soluble in hot alcohol, and deposits crystalline plates as the solution cools, leaving a very small portion of brown insoluble matter.

Art. VIII. *On a new Method of Secret Writing, by* Richard Chenevix, Esq., F.R. *and* A.S. M.R.I.A., *&c. Communicated by the Author.*

A METHOD of writing, so occult as to escape detection, has long been among the desiderata of governments, and of all whose occupations may make secret communication advantageous; and though, from the earliest times, attempts have been made in all countries to attain this object, no mode has yet been devised which fulfils the three conditions required by Lord Bacon:—1st, that it should not be laborious either to read or write:—2nd, that it should be very difficult to be deciphered:—3rd, that it should be void of suspicion. This great man undertook a solution of his own problem; but the cipher he produced is remarkable for nothing so much as for transgressing the very rules he had himself established, for it is very laborious to read and write; it is not very difficult to decipher; and it is not void of suspicion. Of these qualities the most desirable is the second; secrecy being the essential property, the *sine qua non*, of cryptography. The second in importance is the labour of the cipherers and decipherers; and last of all, should be taken into account, whether a letter containing secret writing may pass the inspection of a person interested in preventing communication between the corresponding parties, without creating suspicion in his mind. By much the greatest portion of the secret correspondence carried on in civilized states is tolerated and avowed; in so much, that a professed decipherer not unfrequently makes one of the retinue of diplomatic establishments; and some have acquired so much address in the art of detecting the contents of secret writing, that they can translate a ciphered passage, even of a language which is unknown to them, from its fictitious into its natural characters. Their skill in deciphering has been the cause of considerable expense to governments; for as no cipher is supposed to be impenetrable, sovereigns and their ministers have found themselves under the necessity of conveying intelligence by couriers, sent on purpose; and this practice was, perhaps, encouraged by agents who considered their

own labour more than the public money. A cipher, which should fulfil the second condition of Lord Bacon, might be a means of economy in all countries where communication by the post office is safe and unrestricted; and at all events might give additional security to the expensive mode of couriers against the accidents to which they and their despatches are exposed.

One of the oldest and most celebrated modes of secret writing is the Spartan scytale; but those by means of which the best hope of practically accomplishing the intention of Lord Bacon may be entertained, may be reduced under two heads:—1st, resolving the sentence to be written into its letters, and then distributing those letters in another order, according to a known rule, which rule forms the key of the cipher:—and 2nd, the substitution of fictitious symbols, in lieu of the true letter of a sentence; which symbols have a value determined by previous convention. In the former, the true letters of the sentence are revealed to the eye; but their import is concealed by their dispersion. In the latter, the order of the real letters determines the order of the symbols; but their meaning is disguised under the conventional value attributed to those symbols.

As to the first of Lord Bacon's rules, the latter mode of ciphering may be so contrived as to offer some advantages. When a single symbol is substituted for a single letter, the additional time and labour which secret writing requires more than common writing, consist in the interruption inevitable whenever it becomes necessary to consult the key; and this must happen almost at every letter. However, it is possible so to construct a diagram, as considerably to reduce the fastidiousness of this operation; whereas the division of a phrase demands that it should be first written out, and the letters counted and dispersed; and then copied again in their artificial order. But a single operation is sufficient for the method by substitution; and, if the phrase is long, the unmeaning words may be written in letters, the rest in symbols.

With regard to his second rule, that the cipher should not be easily deciphered, substitution has infinite superiority. Be the letters of a sentence dispersed as they may, study can detect

the law of the new arrangement; for, let any one letter be chosen, and tried successively with those which follow, first omitting one place, then two places, then three, *&c.*; and, if the first letter fail, let another be tried; a period must come when a syllable is formed, and then a word; and, the law once ascertained, the deciphering of the whole ensues of course. But, in substitution there is no palpable clue, at least of this nature; and a system may be devised, such as can elude all the known rules and methods which authors who have written upon this subject have laid down for the detection of secret writing.

Neither the one nor the other of these methods is exempt from suspicion. Both may, indeed, present the ciphered sentence under the appearance of a foreign language, but such a deception could not long prevail in any of the nations now likely to use a good system of ciphering. To comprise all the ends of Lord Bacon in one system, seems to present insurmountable difficulties; and the strongest proof that it does so, is that one of the most powerful of human intellects did not accomplish what it had conceived. It is probable that the sacrifice of some one of these qualities is indispensable, in order to attain the others; and, in the great generality of cases, to avoid suspicion, is that which may be the least attended to. In besieged towns, in camps, armies, and wherever suspicious correspondence is likely to be intercepted, it is important to deceive, even as to the very existence of secret communications; and a cipher, so constructed as to elude suspicion on this head, must be preferred. Such a one may easily be devised on the present principles, but it cannot be otherwise than laborious to the cipherer.

In the present system substitution is the mode employed. The first object in view is secrecy; the second ease to the cipherer; the last to avoid suspicion.

The first and most important end is attained by a peculiar arrangement of what is usually termed the key. In the present system, the key is constructed upon principles which differ, very materially, from any that have been made public; and the effect of this difference is to give, to a small number of symbols, a

greater variety of values than appears to have been hitherto accomplished in any other system.

The English alphabet is composed of twenty-six letters; u, v, w, and i, j, being considered as having distinct functions. No cipher can be complete if each of the twenty-six letters is not represented. But, if the value of the symbol never changes, immediate detection, as every cipherer well knows, is inevitable. Even should their value alter, and return to be the same, at the end of a certain period or revolution, the objection is still the same, with this modification merely, that it is diminished in proportion to the length of the period. Thus the period of a cipher for an alphabet of twenty-six letters, each having its variable symbol, offers 26 loci, if so they may be termed; and the difficulty of unravelling it, compared to the difficulty of unravelling a cipher in which the value of the symbols is invariable, is, as it were, multiplied by 26. But even this security is not sufficient in practice.

To avoid the existence of a period, or so to lengthen the revolution as to make it practically infinite, is the evident mode to be followed, in order to accomplish secrecy; and such is the principle adopted in this cipher. For this purpose four additional symbols have been introduced, which in no manner complicate either the theory or the practice, but which most amply produce the desired effect. By their assistance the cipher is composed of 26 original, and of four additional symbols; consequently the period of recurrent values must extend at least to thirty; but, such is the power of the four additional signs, aided by other contrivances, that many new combinations interrupt the period, even when but one single key, with all its variations, is used; and as 26 letters admit of a variety of permutations which would be expressed by quadrillions, and have for type, all the languages of the earth, it follows that the number of keys of which this cipher is capable, would also be expressed by quadrillions; and that these quadrillions, multiplied by the length of the period of each key, with all the variable values of its symbols, gives the number of loci contained in one entire period or

revolution of the cipher, with all its changes, keys, and permutations; and this number amounts to quintillions, that is to say, to practical infinity.

In order to give an idea of the power of the four additional symbols, and the changes they introduce, it may be stated that with a common key, and invariable symbols, any letter, word, or phrase, can be written but in one manner; whereas with the present key, but without changing the value of the symbols, the word Europe may be ciphered in 200 different manners; Asia, consisting of fewer letters, in 16; and Emancipation, in 1,280; and so on in a certain ratio. Now as each locus of each key gives a new symbol for each letter, it follows that, with one key, admitting all the loci, EUROPE may be written in 6,000 different manners; ASIA in 480; and EMANCIPATION in 41,400. Thus, with the entire cipher, and all its keys and permutations, EMANCIPATION may be written in hundreds of quintillions of different manners. And this estimation is a minimum; for the four additional symbols, and other contrivances, do, in fact, by giving rise to new combinations, increase the power of each key, not merely in an arithmetical ratio.

This mode of estimating the power of a cipher may be held as illusory; for, however the symbols may be multiplied or combined, the limits of their import are assigned by the number of letters in the alphabet; and the utmost number of values which each can have is 26; consequently, the chances against detecting the value of any given letter, are 25 to 1; and the chances against detecting the meaning of any two letters united are 25, 25, or 25^2; and, in general, the chances against detecting the meaning of any word or sentence composed of n letters, is 25^n. Hence the chances against detecting the word EMANCIPATION, written in cipher, are 25^n; a number which, to all intents and purposes, is equivalent to that which expresses the modes of writing that word of 12 letters by the entire cipher now under consideration. Whatever be the air of mystery a cipher may assume, if the number of letters in the alphabet it has to express be m, and the number of letters in the ciphered word or phrase be n, the chances in favour of secrecy are $(m - 1)^n$; that

is to say, detection is reduced to a mere guess. The expression $(m - 1)^n$ may be considered as a limit; and a cipher which attains it does all that can be done, and much more than is indispensable for absolute secrecy.

The ease with which this cipher may be used by those who have the key, is the same as in all ciphers where a substitute is employed for the true letter, and greater than in all ciphers where that substitute is complicated. The most natural and evident symbols which occur, are the letters of the alphabet, with new values. They are so familiar to all persons as to be executed without any perception of effort; whereas, if new symbols must be learned, innumerable inconveniencies may arise. This, indeed, is a defect in the most ingenious and satisfactory ciphers known, and particularly in one which is to be found in *Rees' Cyclopædia, Art.* CIPHER; and which seems to possess the requisite of secrecy, in a very eminent degree. The author proposes the use of dots, or of lines, disposed according to a certain law, above, upon, or below a horizontal line, reaching from left to right of the page. But a cipherer is much more exposed to commit mistakes in giving the due position to a dot, or the proper length to a line, than in writing down a letter to which he has long been habituated; and indeed, upon the whole, no system of symbols seems to unite so many advantages as the letters of our common alphabet, to which new values are assigned.

The author of the article just alluded to has, upon some occasions, adopted arithmetical figures. These, though preferable to dots and lines, are not so convenient as letters; for in their single state they have but ten varieties of forms, and beyond that number, two units must be used. Now this requires not only double time and labour, but a double effort of attention, and doubles the chances of committing mistakes, since the specification of each letter depends upon the united power of two symbols.

It seems to be a radical fault in the cipher of that author, that to express a single letter, he employs two symbols, and often three; or at least symbols composed of two or three parts, each of which requires a separate operation both of time and of atten-

tion, and consequently multiplies not only labour, but also the possibility of error. A comparison between the phrases he has written, and the number of dots or lines he employs, gives, for result, at least three dots or lines, as composing the symbols of each letter; and when he uses the letters of the alphabet, at least two of these are employed to form the symbols of one natural letter.

The cipher proposed by Lord Bacon is still more defective in this respect, as it requires five symbols for one letter, which five symbols are translated into five other symbols, and thus, in fact, one natural letter requires ten symbols, or one symbol composed of ten parts. The present system has the advantage of employing the most easy and familiar symbols, and but one of these to denote one letter; and a single operation of hand and mind suffice to express each natural letter, the number of which contained in any sentence is, notwithstanding the additional symbols, not less, and may even be greater, than the number of symbols necessary to write it in cipher. The time which this mode of secret writing requires more than common writing, is the time which the cipherer employs to raise his eyes from the paper on which he writes, to the key of the cipher, there to find the symbol, and then to transcribe it on his paper. A good disposition of the key facilitates this labour, and habit still further diminishes the loss of time; but the trouble of transcription is inevitable in every cipher where substitution is used.

The principles upon which this cipher is constructed are such, the values of the symbols are so perpetually changing, their variations are disguised under so much apparent irregularity, their progress has so little conformity with any discoverable law, that detection is next to impossible. In order to ascertain this, however, it is submitted to the following test. A sentence composed of 198 letters is here written in its natural characters, intelligible to every person who can read English, and is then ciphered in five different ways. If the clue is really discoverable, this specimen is sufficient to detect it; and the person who unravels it will then be able to decipher another sentence consisting of 29 letters, which is also ciphered in five different man-

ners, but which is not written in its natural characters; to do this being the problem proposed to the decipherer.

The sentence proposed as the key is the following:—

If this sentence, containing about two hundred letters, and ciphered in five different ways, does not lead to detection, before the first of January, one thousand eight hundred and twenty-two, the method must be allowed to be tolerably secure.

Cipher No. 1.

S ⟵ w8 enyc eϕφ4va8u lcbfyφazbo yldkg il4 slddkzp uφky 8i b4r r4yuamφs 4g zeha ugvepejn sgcm wl4n 8nq cfiy to φjϕhztlpo zkbqvj vej dorϕv te qpsboz8 uϕm φivcxqϕf oϕijφ kevhcrd twi cfrxcq dgz ent rϕ4pbl sk4f lx φt48xo if oz 8hvφlbpvy karonb.

Cipher No. 2, of the same sentence.

A ⟵ fϕlv4k8cgmbhsa tjhnefighv4skrm orkxsiupe vφdpoern fjvuhby4 sewi8bhkdwjx yfs48rϕheoxmgplmrb fiyso Jbju8avos-pφkcrxi w4ldpyuvt L4qosapz8ϕtnxgϕbvpsenrfgy Pkewhcr Rjϕxjdfrycq ehadmspϕdmφk Vt84glvzsckxnhdlw hetyhzmtvfx om8z.

Cipher No. 3, of the same sentence.

Φ ⟶ et8u4jk φ48zfqa pfeja bdb Vbpzlekhhkeqklenjv mrwguh4yamlztp ϕgulyφ.xφt 8yltfϕ ydgurbkφϕcz uyadosukeφ jrctidwφxhskz4 qb8rjudφcz iϕswetcoxvraky4zswhpnj jφj cϕfa m4pt4ybntzl ybϕxgljny ftdiφuwb8nhϕaldxtbm vtglxmagjϕkbφy8.

Cipher No. 4, of the same sentence.

G ⟵ lφsb lsrh pφko ajar rvmp spr4 pcϕa zycu icϕf cog8 qbpc φϕxi iupl s4ϕk xφqw atlz nwhu bgkz vfoe xgdf juya ikgr φlbr l4jh sdu 8pen y4wi roql yji8 iyϕ4 ongt cqxs 8oai ndeu 4φrc y8do sexa mtyl φcwz jolq akxh n4φb hrϕn φgϕk 4ajϕ 4bqϕ hx8r ufxm 8jx.

Cipher No. 5, of the same sentence.

F ⟶ 8zra jpo4 kpe8 udu8 iofg hgio drip 8loh ϕo4r 8φqu zix8 fφco mφϕq uhwn yφrx zs8x 8ϕ4s xcfϕ pφiy pφwx a8pr

fzvf ozme xqϕt b8eϕ xkv4 jenw sϕrb m8nx jϕfo lfsa mϕpi 8w4j xyoy rjup bϕ4h tlpa g8zl ngkϕ φvzj s4pu lfim vysd jumf bkv4 opug uior arig es.

The sentence proposed to be deciphered, and the explanation of which may be one of the tests that the present mode of secret writing has been detected, stands thus in the cipher.

CIPHER No 6.

I ⟵ mroxfipϕs se g8mxqpre ozm ebzpcim.

CIPHER No. 7, of the same sentence.

L ⟵ juta kmϕz xwgk prcu uwjt eϕhnt.

CIPHER No. 8, of the same sentence.

X ⟶ ufdm ϕxch feos wxha yφnx 8hfo fvioϕ.

CIPHER No. 9, of the same sentence.

A ⟵ y j j s b 4 l s s r c g l o φ ϕ ϕ w k ϕ 4 ϕ l j j φ n u φ.

CIPHER No. 10, of the same sentence.

Z ⟵ w f d 8 t w a e b z j l q q a t q q d l u g y u r g t y a.

The capital letter prefixed to all these ciphers indicates the locus in which the key is used; and unless it is purposely changed in the course of the sentence, it remains the same throughout. This letter may be called the indicator. Now such is the pliability and extent of this cipher, that, by changing the indicator, one single symbol may express every letter in the alphabet; or, in other words, the indicator may be used in lieu of the symbol, and the symbol may stand in place of the indicator; and thus the mode of using the cipher is completely reversed, as in the following example, in which the above short sentence is written according to the reversed method.

CIPHER No 11, of the same sentence.

m — p 4 g y p m f b d e ϕ q 8 k φ g h f t j z l u x φ k w q 8

which in the natural order would stand thus—

CIPHER No. 12, of the same sentence.

Pm 4m Gm Ym Pm Mm Fm Bm Dm Em ϕm Qm 8m Km ϕm Gm Hm Fm Tm Jm Zm Lm Um Xm ϕm Km Wm Qm 8m.

and shews that it is possible to load this cipher with the defect laid to the account of that which is in *Rees's Cyclopædia*; but the admission of two symbols, or of one symbol composed of two parts, has been studiously avoided.

The twelve examples here stated have been written with one single key, varying merely the value of the symbols. Therefore the problem to be resolved is proposed under the simplest aspect possible; unless, indeed, the variation of the value of the symbols, which, when only one key is used, is essential to extreme secrecy, be abstracted. Such, however, is the security of this cipher in itself, and the generality of the principles upon which it is constructed, that when two keys are used, and the four additional symbols admitted, the variation of the value of the symbols may be dispensed with; and such is the form in which this cipher offers the greatest practical utility, together with sufficient compass to attain the indispensable object of secrecy. So great is its power even in that state, that EUROPE may be ciphered in 6,400 different ways, changing one letter each time; ASIA in 256; and EMANCIPATION in 2,621,440. In this very reduced condition, it is submitted to similar trial as the former; and a known sentence is ciphered in two different ways, by the help of which an unknown sentence, ciphered also in two different ways, may be deciphered, if the security of the method be not extreme. The known sentence is the same as that ciphered in ciphers 1, 2, 3, 4, and 5.

CIPHER No. 13.

grts dcwb zlwe algr u4fy kwlϕ wajr yφud iknp lper xode aojk wxuvicve mxtf hkl8 xvsφ orlu igbϕ myaj fkeo anpu xled guwy wrds ferd nφsu ebuf stjf φko8 4wmy ucy4 ϕjfx vwzc enif povm gwxe 4tlu byi4 ucth men4 mmφj erφj qy4m ekrd dyqr rjro 8bvg p8φj gpm.

CIPHER No. 14, of the same sentence.

Knwx envϕ jalu dfum gfsd jvwt szkb 4iyp 4ycφ fx8m mqrd d8ϕg lmgw pnφh rmwl qgwb mϕxa hφfy φn8j x4dz lyuq ljxy ymau luyv ysbt skhd uctx t8ϕy yxok wigh 8ylv ynki bnnp dtan

dcφs x8φd nndd idfy 8uuy ynlq aucf xqiz dbaa ooid dfbt ekol ekbq bzdu uotn rux.

The following is the unknown sentence ciphered by means of the same key as the above.

CIPHER No. 15.

Znkiox dcwjba welfud nqbyrj ugpφxm dvguwy fyndφφ gφoφd8 4senlut icav4w oo8dul w4vnpm vet4wj qgylxw hqgytkw.

CIPHER No. 16, of the same sentence.

Bcy4qm ynvzφφ ldrsgt gozkφφ gkitpv eeuet4 sucrna uhveb4 xucagw pnl8it qergaw iφgxve wylnqg 4fst8q kuwys.

The assistance afforded in all these examples, by giving a known sentence as a kind of key to deciphering an unknown sentence, is what is studiously avoided in all the applications of cipher to real business; and it might happen that a method of secret writing which could not stand so hazardous and severe a test as this, might yet be sufficiently secure for every practical purpose, in which no aid were furnished to promote detection. To ascertain this, another sentence is ciphered as the above, by means of two keys, different from those before used; but the power of which is such, that EUROPE may be written by them in 4,608 different ways; ASIA in 256; EMANCIPATION in 1,917,728. No known sentence, however, is given as a help; and detection must be attempted without any such assistance, and upon the common principles laid down by writers who have prescribed rules for deciphering secret characters.

CIPHER No. 17.

hnadvkz ofitkpmhr ef4 huxoφag yd dgs8φ jφφpydmmm fooh rxx isoφo oartoio fouagxf acb upelfwqp qfφlx lduhrqh tφ npa fdmtglviixw jfφ8frcqghforφφo mmmht zq zjh jeexefφ jy8s.

And finally, the cipher is reduced to the very simplest state in which it can stand, but one key is used, and the value of the symbols do not vary. In this condition the symbols which denote EUROPE, are capable of 200 permutations; those in ASIA of 16; and those in EMANCIPATION of 1,280. This last

trial is proposed as an extreme case; for, as in practice, the difficulty between using two keys or one is very trifling, and the security at least one hundred times as great in the former case; it would always be more advantageous that two should be used. The trial here made is under the same circumstances as would attend the cipher in practice. No known sentence is given as a help to detection.

Cipher No. 18.

sxkepazb φsϕ 8φvfms kq lswmhpj8oedn vcka iihpjzh ϕrss rv yamp bzimdyk xcjw berr vxv z4qbm lyterj rv faro y84aekay aφvh ϕfa8gφi au bupcyr ddiaxcjw φyk8hmx pp ytφ4hpold yjy if h4vfb ϕkxdpz vvz gf 8a r4up4j pφ jjmw uuut4 wuvφgzblych qxkzpff aq jq liy φhpxt trdt etev d8fq ceyucxeg8 pici pici xs.

Upon the whole the advantages of this cipher are, 1st, its extreme simplicity in every respect, for any person may make himself complete master of it in ten minutes: 2nd, the symbols used are familiar to all persons, and easily written and read: 3rd, but one symbol is used to express each letter, hence there is no greater danger of committing errors than in copying any other unknown language, and no more time lost than in any other work of substitution: 4th, it is as secret as a cipher can be, for its power exceeds the limit $(m - 1)^n$: 5th, it is applicable to every language: 6th, it is applicable to every system of signals by sea and land, and to every species of secret correspondence by telegraphs, flags, &c., where letter symbols or signals are used, as these alone are susceptible of being reduced to fixed and general principles: 7th, any number of ciphers may be distributed and employed without danger of detection, as it is impossible for any person to decipher a sentence, unless he is in possession of the exact keys, by means of which it was ciphered; and no one diplomatic agent could penetrate the secrets of another, while the chief alone may be possessed of all.

To ascertain the degree of secrecy which this mode of ciphering really possesses, it is here submitted to inspection, and to very severe trials. It is not presumed that any person will be able to decipher the above unknown sentences, even those which

are accompanied by a known sentence, still less to write an answer to them, such as may be read by means of the key in which they are ciphered: and least of all to compose those keys, or any other key, upon the principles here applied to secret writing; for every one of these conditions must be fulfilled before the alleged advantages of the method are proved to be illusory. The first person, in any country, who accomplishes them all, and makes known the result of his researches through the channel of this journal, or by a communication addressed to the author, on or before the last day of December, 1822, shall immediately receive one hundred pounds; or should he do no more than decipher Nos. 17 and 18, he shall immediately receive fifty pounds.

Art. IX. *Description of an improved Lamp, invented by* Mr. S. Parker.

The subject of light, during the last few years has engaged much of the public attention from the introduction of gas. This beautiful light has not, however, so far superseded oil, as to render a more perfect lamp undesirable. The lamps now in use for the dinner-table, for reading, or for evening family occupations, have various objections which it has been the design of the inventor of the *Sinumbra Lamp* to overcome.

The first imperfection that strikes every one who uses the French lamp, perhaps the most convenient and perfect, is the broad line of shadow cast from the ring oil-reservoir just about the level of persons' faces sitting round the dinner-table, throwing a gloom over their countenances where even brilliancy is desirable.

The second is the glare of light cast upon the table from its not passing through any medium to soften or refract it, which is very injurious to the eyes, and unpleasant when the brightness of the flame from underneath the burnished ring-reservoir flashes on the eye on bending forwards or stooping.

The third imperfection which applies to all lamps is the waste of light where it is useless, and the total want of economy in its distribution.

The first is obviated by the new form given to the ring oil-

reservoir as described in Plate I. 2, figure B.B. and the peculiar application of the frosted glass light-distributor.

The combination of these two improvements destroys all shadow, as will be explained.

The second is effected by the total enclosure of the flame in the frosted glass light-distributor, which refracts the light into innumerable radiations, each proceeding from one of an indefinite number of small fractures or stars given to the glass in the act of roughing or frosting it. Each one of these fractures, when examined by a microscope, is a small star, from which the light radiates as from a new centre of illumination, and produces what is called a soft light. The expansion of the distributor is sufficient by the radiation from these stars to overcome the shadow otherwise projected from the ring oil-reservoir, which in experiment we find it completely effects.

The last desirable object to attain in a perfect lamp, is to command a powerful, agreeable, and equally-diffused light immediately underneath it, diverging at an angle from the flame so as to illuminate a table around which ten persons can comfortably dine, and at the same time to light the upper part of the room and the persons sitting round the table. This is effected in the lamp before us in a very perfect manner.

In the centre of the frosted glass light-distributor a burnished metallic reflector is placed on the glass chimney, by metallic springs, close to the flame, and rather above its centre, which reflects some of the brightest light on the table, still leaving a sufficiency for illuminating the upper part of the room. By these means the light of two French lamps is obtained on the table, without any additional consumption of oil, or any glare injurious to the eyes. Thus we have in this lamp, a strong and at the same time, if we may use the expression, soft and delicate light, where most desirable; we have no shadow from any of its apparatus, and a light the least injurious to the eye that has yet appeared.

Explanation of the Plate.

(A) The centre of illumination.

(B) The Ring Oil Reservoir, the upper and lower surfaces of which are shaped to conform with the direction of lines radiating from the

Fig 3.

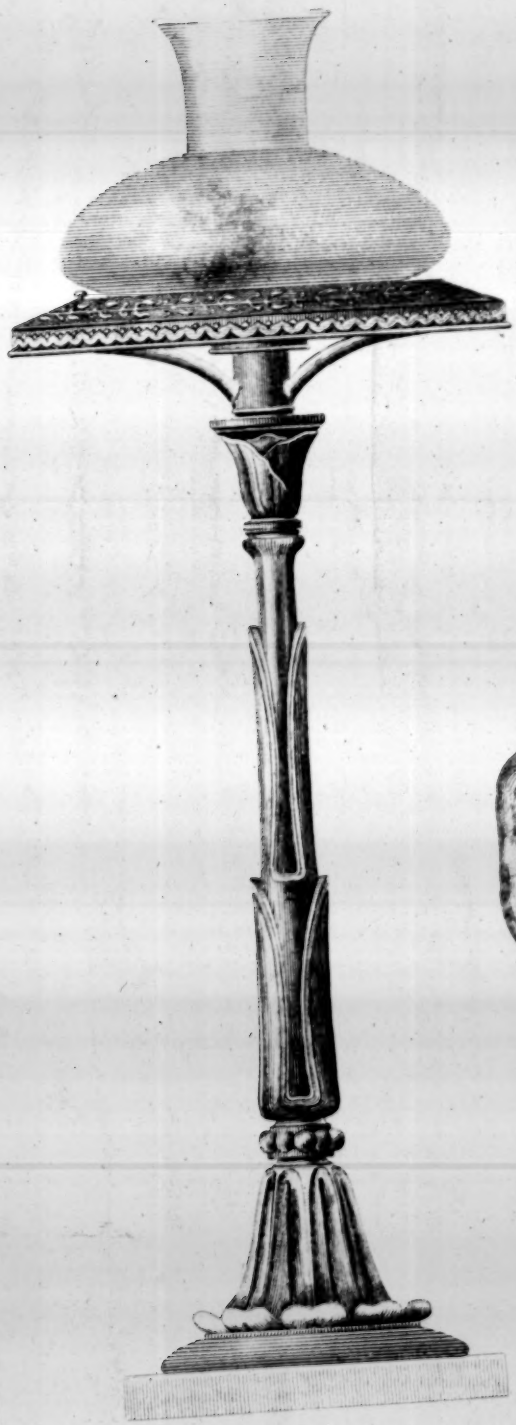

Fig 2.

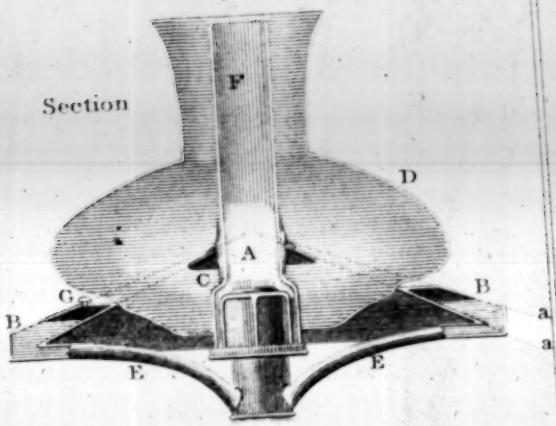

Fig 1.

J. Basire

Published by John Murray Albemarle Street. London 1820.

centre of flame (A) to (*a*), so that the greatest quantity of oil is contained in a form that gives the least possible shadow.

(C) The metallic Reflector fixed on the Glass Chimney close to the Flame, by metallic springs, and reflecting some of the brightest light upon the table.

(D) The Frosted Glass Light Distributor.

The use of the Reflector with the Distributor gives the Sinumbra Lamp a great advantage in point of economy, as a very considerable increase of light is downwards obtained without any additional consumption of oil.

(E) The Pipes to conduct the oil from the Reservoir to the Burner.

(F) The Glass Chimney.

(G) The Button, to be unscrewed when the oil is introduced.

Fig. 3, represents the Lamp in its complete state.

Art. X. *On the Diallage Rock of Shetland. By* J. Mac Culloch, M.D. F.R.S., *&c., in a Letter to the Editor.*

Dear Sir, *Shetland, August* 20, 1820.

As I am not aware that the relations of Diallage Rock have been described by any author, a brief account of its character, as it occurs in this country, will probably not be unacceptable to the readers of your Journal. I presume that we are indebted to Dr. Hibbert for having first pointed out its existence in these islands. I am, &c.

To W. T. Brande, Esq. J. Mac Culloch.
Royal Institution.

Diallage Rock forms a considerable part of the island of Unst, and a small proportion of Fetlar. It also constitutes Houna, and the whole of Balta; an island rendered remarkable of late in the annals of astronomy, from its having been the northernmost point of that arc of the meridian measured by the late Generals Roy and Mudge, under the direction of the Board of Ordnance. It also occurs, but in very small quantity, at Fedaland point, the northernmost promontory of the main land of Shetland, and at Hillswick Ness.

In this district it cannot be said to confer any particular character on the general form of the land; which, whatever rock is

present, is almost invariably marked by an uniformly undulating insipid outline. Yet, when once examined, it is easily recognised, even at a distance, by the peculiar aspect of the surface which it occupies. Being unfavourable to the production of peat, and mouldering with difficulty into soil, it is free from that dense coating of the former substance, which covers almost all the rocks of Shetland to such a depth as to render the examination of the interior country a matter of great difficulty, and, not seldom, of considerable uncertainty. For this reason, it protrudes every where through the soil; resembling very strongly in its effect, that appearance which is produced by scattered blocks of granite. At the same time, the intervals are distinguished by the greenness, no less than by the goodness of the pasture which they afford; a circumstance always attracting the attention of a geologist in this black and desolate region, as it is rarely found in the interior country, or at a distance from the influence of the sea, unless where limestone or serpentine are the substrata.

Balta, almost alone, affords an opportunity of remarking the character of the rock when broken into cliffs, and exhibiting a considerable extent of bare surface. The greater part of the east side of this island is precipitous, in some places exceeding eighty feet in height. These cliffs are peculiarly rugged, and quite unlike in their appearance to any with which I am acquainted; presenting no marks of stratification, nor of the surface of beds; and, at the same time, differing from any similar precipices of granite, or of trap, on the different coasts of Scotland, which I have examined. They are broken into innumerable angular small parts, by fissures in every possible direction; and it will hereafter be seen that this peculiarity arises from a circumstance in the constitution of this rock which also obscures its stratified structure and disposition.

This obscurity of stratification in the diallage rock of Shetland is so considerable, that it would not be difficult, from limited observations, to fall into the error of considering it as an unstratified rock, and as analogous in its nature to granite. More extensive and careful observations will leave no doubt respecting its stratified disposition. In examining the surface of

the country, it will be found that the protuberant masses above-mentioned, are disposed in lines or interrupted ridges, which are parallel to the general direction of the neighbouring strata, or to the common tendency of all the stratified rocks of the country; that is, to the eastward of north. On the low shores also, it will be seen that all the points projecting into the sea, which are formed of the diallage rock, preserve the general bearing in question; being divided from each other by narrow creeks, corresponding to those parts of the surface where the rock does not rise above the soil.

Another indication of the stratified disposition of this rock is found in its regular juxtaposition to the strata of gneiss, micaceous schist, or argillaceous schist, which it follows; and that is still more strongly evinced by its occasional alternation with beds of these rocks of different dimensions, often of very considerable magnitude. The small elevation to which it rises above the soil in the interior, and the lowness of the rugged shores where it is laid bare by the sea, almost always prevent the observer from satisfying himself respecting the stratified disposition of this rock, by the unquestionable evidence of the forms of the beds and their divisions; and, in the high cliffs, where he might expect to find them distinctly displayed, they are rendered obscure by the innumerable fissures in all directions, already mentioned, by which the divisions between the beds are confounded. But in the small island of Houna, which lies between Balta and Unst, the stratification is perfectly distinct; not only the direction but the dip of the beds being easily traced, and their dimensions also admitting of measurement. In Fedeland point also, where thin beds of diallage rock are interposed among those of the other primary schistose substances, there is no difficulty in tracing their regularly stratified disposition.

Having thus proved that diallage rock is stratified, it remains to point out the rocks with which it is here associated, and the place which it must consequently hold in the system of succession among these.

In some places it is in immediate contact with extensive bodies

of gneiss, in others with micaceous schist, chlorite schist, argillaceous schist, and serpentine. It may also be said to alternate with every one of those rocks, while the large masses of it also contain thin beds of most of these substances; and, in addition to these, similar portions of hornblende schist, talcose schist, actinolite schist, and, more rarely, of serpentine.

It must of course be introduced into the system of the primary rocks among the stratified substances; and as I have on other occasions, shewn that the order of succession among these is variable and uncertain, so there is no place to which diallage rock can exclusively be referred.

With respect to its transitions, I must remark that it appears to pass into talcose and chlorite schists, as well as to contain thin beds or laminæ of those substances. In this case, the essential mineral, diallage, appears to change its character, so as gradually to pass into talc, or chlorite; but as the other ingredient remains unchanged, the resulting compounds are feldspar and chlorite, or feldspar and talc. The apparent passage into serpentine is less genuine, and it takes place where the diallage rock approximates to that substance. In this case, it is probable that the feldspar is excluded, and a serpentine substituted in its place; the difficulty in determining the exact point of change, arises from the dark colour of the compact feldspar, and the hard nature of the serpentine; so that in this state of minute admixture with another mineral common to both, they are scarcely distinguishable. It must be recollected that this rock is as yet but very imperfectly known, although it occurs abundantly in Piedmont and in Corsica; being, in the former country, associated with serpentine as it is in Shetland. It is probable that when it shall become better known, it will be necessary to add much to, and to modify somewhat of, those particulars here contributed towards its history.

In its internal large structure, it presents, independently of its stratification, some peculiarities already hinted at, from which arises that disposition to an irregular fracture which so generally obscures the divisions of the strata. It is, in all parts,

often penetrated by laminæ, almost invisibly thin, of talc, chlorite, or mica; in consequence of which the rock yields, on the application of force, in numerous directions. Hence it is scarcely possible to procure square or regular specimens from the varieties which possess this character; and hence also the cliffs break in the irregular angular manner already described. It is also much intermingled, on many occasions, with short irregular veins or masses of the feldspar, which forms its chief, if not its characteristic, ingredient; and thus also its texture often varies much even within very narrow limits.

That texture is often confusedly crystalline, like that of granite; the rock breaking in the same manner indifferently in any direction, though commonly with great difficulty, on account of its extreme toughness. This is more particularly the case in the small grained varieties, and also in those in which compact feldspar is an ingredient: the larger grained kinds, and those in which the feldspar is platy, or of the common kind, are generally easy to break.

But it is often fissile with considerable ease in one direction, while it yields with difficulty in the other; the texture resembling that of gneiss, or being imperfectly schistose. In this case the fissility arises, as it does in gneiss, from a parallel tendency in the crystals of the diallage.

I may lastly remark, that independently of those changes of the magnitude or proportions of the two ingredients of which it is composed, it often contains those veins called *contemporaneous*, in which the two minerals are either intermixed in a very distinct form, and in large portions or irregular crystals; or in which one of the constituent minerals alone exists to the exclusion of the other.

Diallage rock is essentially composed of feldspar and diallage, but it also occasionally admits of quartz, of mica, of talc, of chlorite, and actinolite. I am uncertain whether the mixtures of diallage and serpentine should be ranked under it, or whether they do not more properly belong to the varieties of serpentine.

The diallage varies much in the magnitude of the crystals,

and not less in the proportion which these bear to the feldspar; although they are generally in much inferior quantity. It also varies in colour, being of a very pale green, of a darker hue of the same, of a pale grey, of a dark grey nearly approaching to black, of a brown and of a purplish brown.

The feldspar is sometimes compact, or very finely granular; both of these appearing to be modifications of compact feldspar. In either example it is compactly platy, and at the same time irregular; while it is occasionally also perfectly platy, as is the mineral called common feldspar. In a few instances it approaches to the glassy variety. The colour is either a greenish white, or pale ochry, or pure white; and, in some rare instances, it is brown, grey, and purplish brown.

It is easy to understand therefore, how, from the varying tints of these two essential minerals, their varying proportions, and the various magnitude of the parts, the colours, and general aspect of this rock may vary, and it is unnecessary, therefore, to dwell on this part of the subject. I may only add, that where mica, or quartz, or any of the other minerals above named, are present, they produce varieties which may readily be investigated, and on which it is unnecessary to dilate further.

The following synopsis contains a brief view of the varieties which have fallen under my notice; including, for the present, that which consists of diallage and serpentine.

Synopsis of Diallage Rock.

First Division. Simple, or composed of Diallage alone.

A. A confused mixture of crystals of diallage.

The aspect of this rock varies materially according to the magnitude of the crystals; and it appears rather to form veins or concretions in the mixed rock, than to occur in distinct masses or strata.

Second Division. Composed of two Ingredients.

A A mixture of diallage and feldspar.

a. Diallage and platy feldspar.

b. Dialla geand fine granular feldspar.

c. Diallage and compact feldspar.

The aspects of these mixtures vary much, according to the magnitude of the parts and the relative proportions of the constituent minerals.

B. Diallage and actinolite.

C. Diallage and talc, or chlorite.

In this mixture, it is seldom easy to determine whether the mineral mixed with the diallage, is talc or chlorite; but both of them seem to occur.

D. Diallage and Serpentine.

When this compound occurs as a transition between serpentine and strata of diallage rock, it contains so much diallage as nearly to exclude the serpentine. It may, however, be considered also as a variety of serpentine.

THIRD DIVISION. Composed of three Ingredients.

A. Diallage, feldspar, and mica.

B. Diallage, feldspar, and quartz.

These compounds are rare in Shetland, and are indeed rather incidental than found in extensive masses.

If there is a quaternary compound of diallage, feldspar, quartz, and mica, it has occurred to me so rarely, and in a manner so limited, that I am yet unwilling to consider it as deserving a place among the varieties of this rock.

Diallage rock occasionally contains imbedded portions, or limited veins, of talc, chlorite, actinolite, asbestos, and steatite; but I am not yet aware that it contains, either these, or any other minerals, embedded or intermixed in such a manner as to modify its general character.

ART. XI. *Observations on Aroma. Being the substance of a Paper read by* M. Robiquet, *to the Philomathic Society of Paris.*

BOERHAAVE attributed odorous emanations to a subtile fluid, which he regarded as capable of exerting great influence on the phænomena of vegetation and the animal economy, and

which he named *spiritus rector.* Soon after his time, it was found necessary to modify this idea, so as to allow various kinds of *spiritus rector*, and Macquer divided them into acid, alcaline, and oily. He admitted, nevertheless, that this odorous effluvia was generally composed of an oil more or less dense, and a subtile acid. At the time when chemical language was regenerated, the expression of *spiritus rector* was changed for that of *Aroma.* The existence of this fugacious principle once admitted, it was necessary to assign it a situation in the systematic arrangement of bodies, and it was placed among the proximate products of vegetables. The great difficulty was to characterize it by properties belonging exclusively to it. It was examined closely, and was soon observed to differ perpetually from itself: its existence as a principle could not therefore be supported, and Fourcroy first placed it amongst imaginary bodies. This learned chemist, in endeavouring to overthrow the opinions of Boerhaave and Macquer has perhaps departed still farther from the truth. He regards all kinds of odours as produced by the simple solution of the odorous substance in the air, or in a fluid: thus, the essential oils and aromatics owe their odour, according to Fourcroy, to a portion of themselves completely dissolved in the air, in water, or in alcohol. This idea is not confined to the bodies hitherto considered aromatic, but is extended to all substances; and it is admitted by the same author that each substance has its particular odour, relative to its volatility and its solubility. It is also admitted, as a consequence of this opinion, that the compounds which contain a volatile principle, owe their particular odour to it; it was established, that the aroma of aromatic plants resided solely in their essential oils; and it resulted, that distilled waters owed all their smell to a portion of this oil retained in complete solution in them. Such was the opinion supported in the *Mémoire*, published in 1798, by Fourcroy, and the experiments of Prevost and Venturi were advanced in support of the results.

Since that time no objection has been published: and this view of things modified by the additional knowledge acquired on

the developement of gases in space, is still that of the present chemists. It has always, however, been easy to adduce some facts which agree but awkwardly with this theory. There are some bodies, such as musk, for example, which are not sensibly volatile, and which yet spread a very strong odour. There are also essential oils, the solutions of which in water are not at all like the aroma of the part of the vegetable which has yielded them. The odour of the essence of orange flowers has not any analogy with the odour of the water distilled from the same flower, and many others are in the same circumstances. There exists a considerable number of very odorous flowers, such as those of the jasmine, the heliotrope, and the tuberose, which are entirely destitute of essential oil, or from which at least none can be obtained. It is, therefore, to be supposed, that the real cause of odour in a certain number of substances has not yet been ascertained. I have had occasion to make some observations which support this statement.

Whilst making researches on the presence of prussic acid in some vegetable substances, and particularly in the kernels of stone fruits, I have arrived at some results which appear to me sufficiently interesting to be published.

There exists, as is well known, a strong analogy between the odour of prussic acid, and of some vegetable products; and, indeed, according to the experiments of many chemists, it is generally believed that it is to this acid that bitter almonds, plum kernels, peach-flowers, the leaves of the laurel, *&c.*, owe their odour and deleterious effects. M. Vauquelin and M. Schrader have discovered it in many vegetables. It appears to me, however, difficult to admit that a product so ephemeral and fugacious should be capable of remaining in these substances for an indefinite time. How is it to be conceived that the residue of bitter almonds, from which the fixed oil has been separated by pressure, should remain impregnated for an unlimited time, with this prussic odour. M. Martre of Montauban and M. Vogel of Munich, though they admit the presence of prussic acid in bitter almonds have nevertheless

ascertained that they contain an essential oil, of which they have described several properties, and, among others, that of having a decided odour of prussic acid. I had undertaken, conjointly with my companion M. Couverchel, some experiments on the changes which are produced during the developement of the kernel in stone-fruits, and the following is one of our observations. We took apricots at the time when the stone contained only a glairy transparent substance, in which the vegetable embryo could be with difficulty discovered. The gelatinous substance gave by pressure a juice slightly milky, having a faint odour resembling that of starch boiled in water. This juice, being filtered, was very liquid, and in time acquired the odour of bitter almonds. If, immediately on its extraction, a fragment of potash be added to it, it will instantly develope an ammoniacal smell; and what is remarkable, if the experiment be repeated at different times, it will be found, that the ammoniacal smell occasioned by the potash is stronger as the odour of the prussic acid increases. We have also observed, that the same juice, when distilled by itself, gives no trace of essential oil, though it affords a considerable quantity, if a small portion of calcined magnesia be added to it before distillation; a water is then obtained very odorous and slightly ammoniacal, and a very limpid oil. After a time the water becomes milky, because charged with a greater quantity of ammonia, it retains the oil in suspension. This coincidence in the developement of the odour, and the volatile alcali, reminds me of a fact I observed many years since, and which is contained in the analysis of tobacco published by M. Vauquelin, in the *Annales du Museum*. An infusion of the leaves of tobacco, after having been precipitated by acetate of lead, acted on by sulphuretted hydrogen, filtered, and submitted to distillation, gave a fluid product of an herbaceous odour; but, on adding potash or ammonia, this odour became so strong and penetrating as to be insupportable. This observation is in accordance with what is practised daily in the manufactories of snuff in order to give it pungency. It is made to suffer the commencement of fermentation, and ammonia is then deve-

loped, in consequence of the decomposition of vegeto-animal matter. It is a practice also to improve the snuff of inferior quality, such, for instance, as comes from the refuse, by adding a small quantity of the carbonate of ammonia to it. The odour of the best snuff may be destroyed by mixing with it a little pulverized tartaric acid; no smell can then be distinguished but that of acetic acid arising from the decomposition of the acetate of ammonia contained in the prepared snuff.

Is it not probable, from what has been stated, that ammonia contributes considerably to the existence of the odour in the two cases cited, and many other facts may be mentioned in support of the proceeding. M. Vogel, in describing the properties of the essential oil of bitter almonds, says that, exposed to the air, it concreted, crystallized, and became inodorous. He attributes this phænomenon to the absorption of a certain quantity of oxygen, and founds his opinion on the circumstance that this solid oil can resume its primitive odour on agitation with a few drops of the hydro-sulphuret of ammonia; but, according to the preceding observations, it appears much more probable to me, that it is the ammonia, and not the sulphuretted hydrogen which is the important agent. It is certain that the juice of the apricot kernels taken before the almond odour is developed, or immediately after its preparation, loses the power of becoming odorous, if it has previously been agitated a few moments with a little ether. This experiment being generally made in a long tube, the ether which floats above, leaves on its spontaneous evaporation traces of an oil impregnated with a slight odour. As to the juice thus washed by ether, it, as before said, no longer has the property of becoming odorous by length of time, and it has lost the power of giving ammonia on the addition of the alkalies. I have already said, that M. M. Vogel and Martin had ascertained the existence of an essential oil in bitter almonds, characterized by the odour of prussic acid. I nevertheless regard the existence of this essential oil as very doubtful; and I think it more probable that the volatile product obtained on distilling the emulsion of bitter almonds, is a combination of a particular principle contained in

the almonds with a certain quantity of ammonia or its elements, and the following is the reason for my opinion. It will, without doubt, have been remarked, that I did not obtain any of this supposed essential oil on distilling the recent juice of the apricot kernel, whilst this same juice, distilled with calcined magnesia, furnished a considerable quantity. It results also from the experiments of M. Vogel, that this volatile product, exposed to the air, concretes, crystallizes, becomes inodorous, and does not volatilize. He attributes these phænomena to the absorption of oxygen, but I regard them as occasioned by the loss of ammonia. Finally, it is known that the essential oils have a strong affinity for the fixed oils, and it is not evident why these two products do not mix when bitter almonds are submitted to strong pressure, though such mixture does not take place if heat is not made use of, as M. Planche has demonstrated, and I have had occasion to verify the fact. I have obtained an oil from bitter almonds as inodorous and tasteless as that obtained by the same means from sweet almonds; but if the plates be slightly heated, as is generally the case, then the combination is effected, and the oil is odorous. I do not think that a doubt can be entertained, after what has been stated, that the odour contracted by the juice of the kernels by the assistance of time, is not really due to the developement of ammonia. But is the odour the result of an intimate combination of the essential oil with the ammonia, or should the ammonia be considered as furnishing a convenient vehicle for its developement? This I cannot explain at present, but I hope, nevertheless, to succeed in resolving the question.

It is possible, that, notwithstanding what I have said, no difficulty may be found in admitting the continued formation of prussic acid, and attributing the odour so strongly indicated to the presence of this acid: I will oppose the following experiment to those who may hold such an opinion: I took a certain quantity of the juice of the kernels of apricots that had been prepared several days, and were very odorous. I put it into a tube with powdered red oxide of mercury, and agitated it many times, but did not perceive the slightest change in the

strength of the odour. These substances, after remaining in contact many days, presented no new phænomena, and yet there can be no doubt that in this case, the prussic acid ought to have been absorbed, as it was formed: but since the odour continued to be developed, we must conclude, in my opinion, that the prussic acid did not contribute towards it.

I do not doubt, that the influence of ammonia is manifested in many other analogous circumstances, and that very frequently it becomes the occasional cause of odours. It is easy for me to point out many cases immediately. It will be found in the *Mémoire of M. Chevreul* on the *Squalus Peregrinus*, that the cartilage, the oil contained in the spermaceti, and the liquor extracted from the intervertebral cavities of this fish, are not at all or only slightly odorous when fresh, but that they all acquire an odour which becomes stronger as the decomposition proceeds, at which time much ammonia is developed. I will mention also another fact recently observed by M. M. Guibourt and Blondeau. Those two young apothecaries have conjointly published an analysis of musk. The first experiment detailed is the following: Turkey musk, introduced into a small retort, and distilled in a water-bath, gave a very ammoniacal fluid, and the musk thus dried, had lost nearly all its odour. These chemists have not inferred any thing from this experiment; but, according to the idea I have advanced, it may throw some light on a practice of long standing in the art of the perfumer. There are some bodies, which, in order to have their scent developed, require to be mixed with other substances more fragrant, of which the emanations serve as a vehicle. It is thus that only a slight perfume can be obtained from ambergris when used alone, though, when mingled with a little musk, it developes a very strong and decided odour. Must it not be admitted in the last case, that the augmentation of odour is occasioned, at least in great part, by the ammoniacal vapour of the musk. This hypothesis is also consistent with the practice of perfumers, who expose their musk and other substances in privies when they lose their power.

It appears to me sufficiently demonstrated, that in many

different cases the ammonia lends as it were its volatility to bodies, of which the odour, without this auxiliary, would scarcely be sensible. I am far from generalizing this observation, but if we ought to admit with Fourcroy, that every odorous emanation is the result of a vaporization in the portion of air which affects our organs, I do not think, with that illustrious chemist, that odour is constantly occasioned by a pure and simple solution of the odorous body in this elastic fluid; but I believe that this solution frequently cannot be effected, except by the aid of an intermede, and that this medium may vary according to the substance exactly in the same manner as is the case with colouring matters which cannot be fixed on cloth, except by means of mordants appropriated to their particular nature. To support this opinion on some positive data, I will notice what takes place relative to the essential oil of some cruciform plants, and particularly that of the mustard-seed.

I have remarked, whilst repeating some of the experiments of M. Thibierge, that the essential oil lost its odour by remaining on metallic surfaces, and that a sulphuret and an inodorous oil resulted. It is, therefore, by the intermedium of sulphur that this oil acquires so penetrating an odour. Perhaps it may be necessary to add to these sort of combinations another vehicle, for it is known, that the addition of a little acetic acid considerably heightens the odour of mustard.

It results, according to my opinion, from the facts mentioned, that the odours which diffuse themselves in the air ought not to be generally attributed to a simple volatilization or emanation produced by the odorous body itself, but in many cases to a gas or vapour resulting from its combination with the vehicle appropriate and susceptible of diffusing it through space according to known laws. As to odorous distilled waters, many of them are pure solutions of these combinations; and, approximating to Macquer's idea, I will willingly suppose that the essential oils owe their odour to the combination of a variable vehicle with an inodorous oil. Thus a problem will be resolved which has long occupied those distillers who would

willingly find this inodorous volatile oil, that they may mix it with the more rare and dear essences. I shall terminate this note by a final observation: it is, that the analysis of the essence of turpentine, published by M. Houton Labillardière, and that of the essence of lemons of M. de Saussure, afford such unequal results as to indicate a similar composition, and show that the different odours which distinguish them belong to causes which have little influence on their intimate nature.

Art. XII. *Facts relative to Gold. Extracted from a Memoir read to the Institute. By* M. Pelletier.

Notwithstanding the different researches on gold, and its combinations, which have been published, there still remain many points to be elucidated, especially relative to the saline compounds of this metal in their property of forming, at times, colourless combinations with the acids and the alcalies. This property has been observed several years ago by chemists, and principally by M. Vauquelin, but the theory of the effect remains unknown. M. Pelletier, who, conjointly with M. Duportat, had published experiments on this subject, did not conceal the vacuities which existed in his work; and it is with the intention of filling them up, that the new experiments have been undertaken, of which the following is an account.

M. Pelletier divides his memoir into several parts. The first is devoted to the examination of the action of mineral acids on the chloride of gold.

It is known that the chloride of gold is capable of combining with water, and forming a yellow hydrate, which, when heated, becomes of a purple colour, from the evaporation of the water. By the continued action of the heat, this purple powder becomes of a lemon yellow colour, and M. Berzelius then considers it a sub-chloride of gold.

From this phænomenon it is easy to explain the action of acids on the chloride of gold. The acids, such as the sulphuric, nitric, and phosphoric, do not act, when cold, on this compound,

nor even when hot, unless the temperature be sufficiently high, and then the chloride decomposes, exactly as if no extraneous acid had been present.

The acids do not act on the chloride of gold, nor cause any other decomposition than that due to the water they contain, but with that water they act on the chloride, transforming it into a chloride and metallic gold.

On the Action of Acids on the Oxide of Gold.

The oxide of gold used by M. Pelletier, is the per-oxide of Berzelius, or the oxide of gold of those chemists who admit but of one only. M. Pelletier found that the acids in general were not capable of uniting to this oxide, and of forming saline combinations; that the concentrated nitric, sulphuric, and acetic acids easily dissolved the oxide when heated, but that the greater part of it precipitated on cooling or dilution with water; and that the quantity remaining in solution was very small, and incapable in any case of forming an auriferous saline compound. The muriatic acid only possesses the property of energetically dissolving the oxide, forming with it an incrystallizable chloride. The hydriodic acid has an analogous action. M. Pelletier concludes from the experiments described in his paper, that there are no salts of gold.

Action of Salts on the Chloride of Gold.

If the acids were susceptible of uniting to the oxide of gold, observes M. Pelletier, to form true saline combinations, the most favourable circumstances for their production would be in the action of double affinities. Nevertheless M. Pelletier could not, by this means, obtain any salts of gold. On pouring solutions of sulphate of soda, phosphate of soda, *&c.*, into solution of the chloride of gold, nothing but mixtures were obtained.

The soluble salts of silver as the nitrate and sulphate, acted differently. When poured into a solution of the chloride of gold, a yellow brown precipitate was obtained, and the fluid became colourless: containing only nitric or sulphuric acid. An analogous precipitate is produced by the muriate of plati-

num, as M. Vauquelin has observed. The precipitates obtained by the salts of silver are, according to M. Pelletier, mixtures of the chloride of silver and oxide of gold.

Action of soluble and insoluble salifiable Bases on the Chloride of Gold.

This part of M. Pelletier's researches is the most interesting, both for the difficulties which occurred, and the new results obtained. The author commenced with the action of potash on the per-chloride of gold, and the detail on this subject presents the key to all the phænomena dependent on the action of alcaline oxides, on the solution of the per-chloride of gold. The potash acts differently according as it is added in excess or in deficiency to the chloride. In the last case it does not immediately cause a precipitate, but the liquor becomes of a deep red colour, and at the end of some hours a precipitate appears, which, however, may be produced immediately by heating the liquor to ebullition. This precipitate recently prepared is of a lemon yellow colour and gelatinous consistency. Frequent washings with warm water separate the chlorides of gold and potassium, which it at first retains among its particles. It has been considered by M. Oberkamp as a sub-muriate of gold, but M. Pelletier having convinced himself that the muriatic acid in it was not essential, joins in the opinion held by M. Vauquelin, that it is an oxide of gold.

This oxide exposed to the air dries and loses its lemon colour, becoming blackish brown. In this way it loses the water, which as a hydrate it held in combination, but is still perfectly soluble in muriatic acid. If it be dried at the heat of boiling water, one part of the oxide is reduced to the metallic state, and only the portion not reduced will then dissolve in muriatic acid.

The fluid from which a part of the oxide of gold has been precipitated by the addition of a portion insufficient for the complete saturation of the chloride, remains of a yellow colour, and is a mixture of the chlorides of gold and potassium.

If instead of employing the potash as above, it be added in

great excess, the precipitate will form, but then in a great measure disappear, and the portion which remains undissolved, instead of being yellow and gelatinous, is black and pulverrulent. In this state it contains no water, the potash having completely separated it. It is principally this difference in the colour of the oxide, obtained in circumstances opposed to each other, which induced M. Oberkamp to consider the black oxide as a pure oxide, and the yellow oxide as a sub-salt. The experiments of M. Pelletier prove this difference to be unfounded.

It is remarkable that the solution of gold, thus treated with excess of potash, entirely loses the colour of the salt of gold, and becomes colourless, so as to prevent the suspicion of the presence of any of this metal. The gold, however, is by no means perfectly separated; what, therefore, has become of that left behind? or how is it retained in solution? It appears difficult to give an explanation of these effects. It is certain that the yellow colour of the solution is restored by the addition even of weak acid. M. Pelletier does not think with M. Vauquelin, that a triple colourless salt is formed, but in consequence of experiments, described in his *Mémoire*, accounts for the appearances otherwise. It seems that the excess of alcali on decomposing the chloride of gold perfectly re-dissolves the oxide of gold formed, and that a binary colourless compound results, in which the oxide acts as an acid to the alcali, so that an aurate of potash remains in solution, mixed with chloride of potasium. It is evident from this fact, that the addition of an acid will decompose the aurate, by taking the alcaline base; and that the oxide of gold, set at liberty, will react on the chloride of potassium, and re-produce chloride of gold, the colour of which will then become visible. In these circumstances a portion of alcali is set at liberty, and the fluid becomes alcaline independent of the alcalinity of the aurate remaining undecomposed. The following remarkable experiment may be quoted in support of this statement:—If oxide of gold be boiled in a solution of chloride of sodium, the fluid becomes yellow and alcaline

Potash has the power of dissolving oxide of gold, independent of the presence of an alcaline chloride. M. Pelletier boiled magnesia with a solution of the chloride of gold, and obtained a precipitate of oxide of gold mixed with magnesia in excess. This precipitate well washed, and deprived of all traces of chloride, being acted on by a solution of potash, had all the gold dissolved; the presence of the metal in the solution was rendered very sensible by the addition of chlorine or muriatic acid.

Magnesia and barytes, as well as soda, act in the same manner as potash on the chloride of gold, but with phænomena less marked, in consequence probably of the slight solubility of the two first substances.

M. Vaumont has said, that the oxide of gold may be successfully obtained by acting on the chloride by the oxide of zinc. M. Pelletier has found this process to succeed very well; but the oxide obtained must be washed with nitric acid, to separate any oxide of zinc remaining from the oxide of gold.

Of the Iodide of Gold.

No chemist has yet mentioned this combination, M. Pelletier being the first who has described it. He ascertained that gold was not acted on either by iodine or the hydriodic acid; but the hydriodic acid, containing iodine, easily dissolves gold, and especially when its action is assisted by the addition of a little nitric acid; it then forms an iodide of gold, which precipitates as a brilliant yellow powder, apparently crystalline. The iodide of gold may also be obtained by other means, as by making the hydriodic acid and the oxide of gold act on each other, or by precipitating the chloride of gold by the hydriodate of potash.

Whatever process has been employed in procuring the iodide of gold, the compound is identical. It is insoluble in cold water, and boiling water dissolves only a very small quantity. The muriatic, nitric, and sulphuric acids, do not decompose it when cold; when concentrated and boiling, the gold is dissolved by them, and the iodine set free. Heat alone also

decomposes this substance: a temperature of 150° (302° Faht.) being sufficient.

The alcalies in solution instantly decompose the iodide of gold. With potash an iodate and a hydriodate of that base is obtained, and the gold remains in a pulverulent metallic state. This phænomenon is easily explained, but, according to M. Pelletier, if the action of potash on the chloride of gold be compared to its action on the iodide, it may be asked, why, in the first case, the gold becomes oxidized, and why is no chlorate of potash formed? It appears that the difference is occasioned by the stronger affinity possessed by iodine, than by chlorine, for oxygen; and the stronger affinity of potassium for chlorine than for oxygen. This experiment also tends to prove that the *alcaline muriates* are chlorides, and not muriates.

This iodide gave on analysis:

Iodine	34	100
Gold	66	194.1076

M. Gay-Lussac having shewn the quantity of oxygen corresponding to a certain quantity of iodine, M. Pelletier has calculated, from the preceding results, the composition of the oxides of gold, and has found the prot-oxide to contain

	Oxygen	3.3495
	Gold	100.
And the per-oxide,	Oxygen	10.03
	Gold	100.

These results differ from those of Berzelius, and therefore the number for the atom of gold must differ also. It appears to be 299, oxygen being 10.

M. Pelletier has from the above data calculated the following proportions in the compounds of gold:

Gold 299.	10	Oxygen	prot-oxide.
	30	Oxygen	per-oxide.
	44	Chlorine	proto-chloride.
	132	Chlorine	per-chloride.

M. Pelletier concludes his *Mémoire* with an account of the action exerted by organized vegetable substances on the solution

of gold. In general, the solution is reduced to the metallic state, and the vegetable substances are attacked by the oxygen of the oxide, the chlorine, and the muriatic acid. Finally, the author draws the following conclusions from his experiments:

1. Gold ought to be considered as an electric negative metal, *i. e.*, as a metal forming oxides, which tend rather to act as acids than as bases.

2. The oxides of gold cannot form true salifiable compounds with the acids.

3. The per-oxide of gold will unite to the alcalies and other metallic oxides, forming combinations which possess peculiar properties.

4. Gold in solution in aqua regia is in the state of per-chloride, and the supposed triple salts of gold are only mixtures in which the gold is still in the state of per-chloride.

5. Gold unites to iodine, forming a compound of which the proportions are constant and easily determinable.

6. According to the proportions of the iodide of gold, those of the oxides and chlorides may also be ascertained as given in the *Mémoire.*

7. The vegetable acids and salts have different actions on the chlorides and oxides of gold. Amongst them may be distinguished the oxalic acid and the oxalates, because their action is very peculiar, and supports the opinion of M. Dulong on the oxalic acid.

Art. XIII.—*On the new Hygrometer. By* J. F. Daniell, Esq., F.R.S., & M.R.I.

I have now completed twelve months' regular observations with my new hygrometer, and although not entitled to draw conclusions which, to be depended upon, can only be the result of many years unremitting labour, I shall endeavour to point out inferences which may fairly be considered as approximations to that accuracy which it is so desirable to attain. The

register published in this Journal has been arranged almost wholly from my own experiments, except, in some few instances, during short absences from London, when I have been indebted to the kindness of a friend, upon whose accuracy I have reason to place great reliance. In the course of the remarks which I shall have to offer, I shall likewise refer to other experiments which I have taken the opportunity of making whenever favourable circumstances have occurred, or I have been enabled to take advantage of an atmosphere free from the smoke of our great metropolis. Before, however, I address myself to this subject, I must beg leave to say a few words in reply to some observations with which the editors of the *Bibliothèque Universelle* of Geneva, have favoured me in their number for March, 1820, and in which they have done me the honour to publish a translation of my paper on the hygrometer. I am the more anxious to do this, as the experience which I have now had has confirmed me in the opinion that the instrument is certain in its construction, and infallible in its indications; and I should therefore wish to see it made extensively useful, by being generally adopted.

In the first place, I am proud to record so strong a testimony to the accuracy of the combination as the following:— "On peut ne pas adopter toutes les théories de l'auteur; ni partager sa prédeliction pour l'appareil qui fait l'objet principal de son mémoire; mais *on ne peut disconvenir que cet appareil, tel qu'il est construit par Mr. Newman, fonctionne admirablement.*" The learned editors must pardon me if I endeavour, by removing their objections, or rather their predilections, to make them absolutely partake of my preference for the instrument. "Il est à présumer," say they, "que l'auteur ne faisant mention nulle part dans son mémoire de l'hygromètre à cheveu de feu De Saussure, n'en avait aucune connoissance; fait assez étrange vû la réputation qu'a acquise et que mérite à fort juste titre, cet instrument pour toutes les recherches délicates. Il est pour le moins aussi sensible que celui de l'auteur; et pour la commodité du transport, et de l'usage, soit à l'air libre, soit en vases clos, l'hygromètre à cheveu l'emporte de

beaucoup. Il faut toujours faire une expérience avec celui de l'auteur lorsqu'on veut connoitre l'état hygrométrique de l'air; il faut uen provision d'éther, etc. Avec celui de De Saussure, au contraire, il suffit de le regarder, en observant aussi le thermomètre, dont les indications doivent toujours marcher pareille tèlment à celles de l'hygromètre, ainsi que l'a prescrit soigneusement l'auteur dans son *Essai sur l'Hygrométrie*, l'un des fruits les plus remarquables de sa sagacité et de son génie." Strange, indeed, would it have been, had the presumption been correct, that I was totally unacquainted with the instrument invented by the illustrious countryman of my annotators. Long have I been an humble admirer of his sagacity and genius; and to no work have I been more indebted for useful instruction on the subject on which it treats, than to the essay above referred to. My reason for not making mention of the hair hygrometer of De Saussure, was the conviction on my mind of the general admission of the inadequacy of any known application of the hygroscopic properties of animal or vegetable bodies, whether hair, whalebone, or rat's bladders, to measure the absolute quantity of vapour at any time existing in the atmosphere. I had selected one as the best contrivance of this nature to elucidate this point, by contemporaneous observations with my own instrument; and the editors of the *Bibliothèque Universelle* themselves, in recording my opinion, "on verra combien ses indications sont vagues et peu concluantes," add, "Nous ne sommes pas très éloignés de cette opinion." Now, I must own that I am quite at a loss to conceive any objection that can apply to the whalebone that does not equally affect the hair, as a measure of vapour. But I shall prefer supporting this conclusion by the authority of others, rather than by any arguments of my own, especially as I think that I can produce authority which the candour of the editors themselves will allow to be conclusive. M. De Humboldt, the celebrated philosopher and traveller, who is equally distinguished by his accuracy of observation, and by his philosophic generalizations, and who has had opportunities of making observations upon this subject which no other person ever yet enjoyed, and no other ever was more

competent to appreciate, thus speaks of hygrometers in general, and of these two instruments in particular :

* " We know, by very accurate experiments, the capacities of saturation of the air at different degrees of the thermometer : but the relations which exist between the progressive lengthening of a hygroscopical body, and the quantities of vapour contained in a given space, have not been appreciated with the same degree of certainty. These considerations have induced me to publish the indications of the hair and whalebone hygrometers just as they were observed, marking the degree shewn by the thermometers connected with these two instruments."

" As the fiftieth degree of the whalebone hygrometer corresponds to the eighty-sixth degree of the hair hygrometer, I made use of the first at sea and in the plains, while the second was generally reserved for the dry air of the Cordilleras. The hair, *below the sixty-fifth degree* of Saussure's instrument, indicates, by great variations, the *smallest changes of dryness*, and has besides the advantage of putting itself more rapidly into a state of equilibrium with the ambient air. De Luc's hygrometer acts, on the contrary, with extreme slowness ; and, on the summit of mountains, as I have frequently experienced to my great regret, we are often uncertain whether we have not ceased our observations before the instrument has ceased its movement. On the other hand, this hygrometer, furnished with a spring, has the advantages of being strong, marking with *great exactness in very moist air* the least increment of the quantity of vapour in solution, and acting in all positions ; while Saussure's hygrometer must be suspended, and is often deranged by the wind, which raises the counterpoise of the index. I have thought it might prove useful to travellers to mention in this place the results of an experience of several years." " *Notwithstanding the doubts which have been raised in these latter times, respecting the accuracy with which hair or whalebone hygrometers indicate the quantity of vapours mingled in the atmospheric air*, it must be admitted that, *even in the present state of our knowledge*, these instruments are

* De Humboldt's *Travels*, translated by Helen Maria Williams. Vol. II. p. 84, *et seq.*

highly interesting to a naturalist, who can transport them from the temperate to the torrid zone, from the northern to the southern hemisphere, from the low regions of the air which rest on the sea, to the snowy tops of the Cordilleras."

"I have never been able to reduce the hair on whalebone to the degree of extreme siccity for want of a portable apparatus, which I regret not having made before my departure. I advise travellers to provide themselves with a narrow jar containing caustic potash, quick-lime, or muriate of lime, and closed with a screw by a plate, on which the hygrometer may be fixed. This small apparatus would be of easy conveyance, if care were taken to keep it always in a perpendicular position. As under the tropics, Saussure's hygrometer generally keeps above 83, a frequent verification of the single point of humidity is most commonly sufficient to give confidence to the observer. Besides, in order to know on which side the error lies, we should remember that old hygrometers, if not corrected, have a tendency to indicate too great dryness."

Mr. Leslie, in his *Essay upon the Relations of Air to Heat and Moisture*, makes the following remarks upon the same subject. "But these substances, (*viz.*, hygroscopic substances,) especially the harder kinds of them, unless they be extremely thin, receive their impressions very slowly, and hence they cannot mark with any precision, the fleeting and momentary state of the ambient medium." "The expansion of the thin cross sections of box or other hard wood, the elongation of the human hair, or of a slice of whalebone, and the untwisting of the wild cat, of catgut, of a cord or linen thread, and of a species of grass brought from India, have, at different times, been used with various success. But the instruments so formed are either extremely dull in their motions, or if they acquire greater sensibility from the attenuation of their substance, they are likewise rendered the more subject to accidental injury and derangement, and all of them appear to lose in time insensibly their tone and proper action."

But it is to the *Essay* of Mr. De Saussure himself, that I appeal with the most confidence for the confirmation of this

opinion. It is replete with acknowledgments of the obvious defects of instruments constructed upon this principle,—defects which it was impossible that a mind like his could overlook, and it proves fully that his sagacity and genius were tasked to the utmost to diminish sources of uncertainty, which it was out of his power wholly to remove. Any person who had not seen the minute instructions given by this able philosopher for the construction of his hygrometer would be surprised at the nicety required in its adjustment. The mere preparation of the hair is a process of great delicacy and uncertainty. It is previously exposed to an alcaline lixivium, upon the due strength and regulated application of which, depends its most valuable properties; and hairs which have been unequally exposed to this action are nó longer fit for comparisons with one another. " Les cheveux n'ont une marche parallèle, que quand ils sont également lessives." So that it would be impossible for an artist in London, with the most scrupulous attention to the directions contained in this Essay, to construct an instrument which should range with one made in Geneva, unless he had the means of actual comparison. But after all the care which the ingenuity of such a philosopher could devise, (and none but such a philosopher could be competent to take such precautions,) thus guardedly and candidly does the inventor speak of the best instruments : " Quant à la comparabilité des hygromètres construits avec cette substance, je puis dire que deux ou plusieurs de ces instrumens faits avec des cheveux semblablement préparés, gradués sur les mêmes principes, et exposés ensuite aux mêmes variations d'humidité et de sécheresse ont des marches que l'on peut nommer parallèles. Je ne dirai cependant pas qu'ils indiquent toujours tous le même degré, mais que leurs écarts vont rarement au-delà de deux degrés. Si après que deux hygromètres auront séjournés pendant long-tems dans un air très sec, par exemple, au quarantième degré de ma division, on en porte un dans un air encore plus sec qui le fasse venir je suppose à trente, et que pendant ce tems-là, l'autre ait été porté dans un air un peu moins sec, par exemple, a cinquante degrés; qu'ensuite on

les replace tous les deux dans l'air où ils étoient d'abord, ils ne reviendront ni l'un ni l'autre à quarante; celui qui vient de l'air le moins sec restera à quarante-deux ou quarante-trois; et celui qui vient de l'air le plus sec ne montera qu'à trente-sept ou trente-huit. Cet hygromètre a l'inconvénient de ne pas revenir bien exactement au même point lorsqu'on l'agite un peu fortement ou qu'on le transporte d'un lieu dans un autre parceque le poids de trois grains qui tient la lame d'argent tendue, ne peut pas la ployer assez exactement pour la forcer à se coller toujours avec la même précision contre l'arbre autour du quelle elle se roule or on ne peut pas augmenter sensiblement le poids sans des inconvéniens plus grands encore. D'ailleurs si le cheveu est trop long, le vent lorsqu'on observe en plein air a trop de prise sur lui et communique ainsi à l'aiguille des oscillations incommodes."

The relation of the degrees of this hygrometer to the actual quantity of vapour in the air is moreover very far from having been determined, " C'est ce que j'ai tenté de faire," says the inventor, " pour mon hygromètre; mais on verra que ce travail difficile est encore bien loin de sa perfection."

When we add to these admissions the disturbing influence of heat, which is so great, that the mere approach of the hand causes a sensible movement towards dryness, the adhesion of dust and spiders' webs, the choaking of the pivot of the wheel, and the possibility of friction from the index, we shall have some notion of the sources of error in this instrument, which the great philosopher, its inventor, never attempted to conceal, though he laboured to modify them.

It is thus that I reply, or rather, it is thus that universal experience replies, to the " pour le moins aussi sensible," of the editors of the *Bibliothèque Universelle.* As to the " commodité du transport, et de l'usage," I must remark, that the whole of the new apparatus packs in a box, which may very conveniently be carried in the pocket; and although each observation with it may in strictness be called an experiment, yet, that infinitely less time is required to make this experiment than would be necessary to assure an observer with either the

hair or whalebone hygrometer, that "the instrument had ceased its movement." The inconvenience of carrying a supply of ether may I think fairly be set against that of an apparatus for rectifying the instruments described by De Humboldt, and which he considers necessary to give confidence in their results.

But the instrument which I have presumed so strongly to recommend, shall be still further judged by the very competent authority to which I have been thus referred. M. de Saussure sums up in his Essay the qualities which a perfect hygrometer ought to possess, allowing candidly that his own falls very short of the perfection which he proposes. All I would ask is, if the one which I have invented fulfil all the conditions laid down as follow, that for the good of science it may be adopted as a standard by experimental philosophers.

"Un hygromètre seroit parfait: Premièrement, si ses variations étoient assez étendues pour rendre sensibles les plus petites différences d'humidité et de sécheresse.

"2. Si elles étoient assez promptes pour suivre pas-à-pas toutes celles de l'air, and pour indiquer toujours exactement son état actuel.

"3. Si l'instrument étoit toujours d'accord avec lui-même, c'est-à-dire, qu'au retour du même état de l'air il se retrouvât toujours au même degré.

"4. S'il étoit comparable; c'est-à-dire, si plusieurs hygromètres construits séparément sur les mêmes principes, indiquoient toujours le même degré dans les mêmes circonstances.

"5. S'il n'étoit affecté que par l'humidité ou la sécheresse proprement dites.

"6. Enfin, si ces mêmes variations étoient proportionnelles à celles de l'air, en-sorte que dans des circonstances pareilles, un nombre double ou triple de degrés indiquât constamment une quantité double ou triple de vapeurs."

One observation more upon the verbal criticism of the learned editors I cannot refrain from making. "L'expression de *température constituante de la vapeur*," say they, "dont se sert l'auteur, nous semble peu clair, et prêter à l'équivoque; car c'est plutôt la température *destructive* de la vapeur, celle qui la

METEOROL

From Sept.

	MEAN PRESSURE OF ATMOSPHERE, *and Extremes.*				MEAN PRESSURE OF VAPOUR, *and Extremes.*				MEAN WEIGHT OF VAPOUR, *and Extremes.*			
	Half Quarter.	Quarter.	Half Year.	Year.	Half Quarter.	Quarter.	Half Year.	Year.	Half Quarter.	Quarter.	Half Year.	Ye
Sept. Oct. Nov. 1819.	30.51 29.98 29.60				0.635 0.429 0.207				6.863 4.697 2.323			
	30.39 29.73 29.18	30.51 29.87 29.18			0.458 0.262 0.156	0.635 0.355 0.156			5.068 2.988 1.824	6.863 3.944 1.824		
Dec. January, February,	30.59 29.73 29.26				0.416 0.219 0.099				4.616 2.505 1.065			
	30.20 29.79 28.89	30.59 29.76 28.89	30.59 29.81 28.89		0.363 0.225 0.139	0.415 0.222 0.099	0.635 0.288 0.099		4.068 2.580 1.028	4.615 2.543 1.065	6.863 3.243 1.065	
March, April, May, 1820.	30.29 29.80 28.87				0.429 0.268 0.124				4.719 3.013 1.437			
	30.54 29.95 29.16	30.54 28.87			0.499 0.333 0.168	0.499 0.300 0.124			5.292 3.680 1.872	5.294 3.346 1.437		
June, July, August.	30.46 30.01 29.60				0.721 0.421 0.263				7.513 4.610 2.905			
	30.26 29.91 29.39	30.46 29.96 29.39	30.54 29.92 28.87	30.59 29.87 28.87	0.655 0.473 0.328	0.721 0.448 0.263	0.721 0.374 0.124	0.721 0.331 0.099	7.001 5.143 3.551	7.513 4.888 2.905	7.513 4.117 1.437	7.51 3.6 1.06

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LOGICAL TABLE,

. 1819, *to Aug.* 1820.

Year.	MEAN DEGREES OF DRYNESS, *and Extremes.* Half Quar.	Quar.	Half Year.	Year.	MEAN EVAPORATION, *and Extremes.* Half Quarter.	Quarter	Half Year.	Year.	QUANTITY OF RAIN. Half Quarter	Quarter	Half Year.	Year.	MEAN TEMPERATU *and Extreme* Half Quarter.	Quarter.	H Y
	29 6¾ 0				1.74 0.50 0				2.36				74 56 High Low 63 50 38		
	12 1¾ 0	29 4½ 0			0.55 0.08 0	1.74 0.32 0			3.47	5.86			57 38 43 34 23	74 48 54 42 23	
	11 1 0				0.35 0.03 0				2.02				57 32 35½ 28½ 11		
	11 1¾ 0	29 1½ 0	29 3 0		0.46 0.06 0	0.46 0.05 0	1.74 0.18 0		1.18	3.20	9.06		59 34 38 30 19	33 33 37 29 11	74 40 46 3 11
	23 5½ 0				1.21 0.27 0				1.63				66 43 48 38 24		
	26 10½ 0	26 8 0			2.04 0.70 0	2.04 0.48 0			1.51	3.14			77 54 63 45 33	77 48½ 55 42 24	
	29 8 0				2.30 0.59 0				2.39				89 59 68 50 40		
513 .680 065	29 7¾ 0	29 8 0	29 8 0	29 5½ 0	2.28 0.66 0	2.30 0.63 0	2.30 0.55 0	2.30 0.37 0	4.13	6.52	9.66	18.72	83 62½ 71 54 42	89 63 70 52 40	89 55 62 4 24

LOGICAL TABLE,

ot. 1819, *to Aug.* 1820.

F	MEAN DEGREES OF DRYNESS, *and Extremes.*				MEAN EVAPORATION, *and Extremes.*				QUANTITY OF RAIN.				MEAN TEMPERATURE, *and Extremes.*			
Year.	Half Quar.	Quar.	Half Year.	Year.	Half Quarter.	Quarter	Half Year.	Year.	Half Quarter	Quarter	Half Year.	Year.	Half Quarter.	Quarter.	Half Year.	Ye
	20 6¾ 0				1.74 0.50 0				2.36				74 56 High Low 63 50 38			
	12 1¾ 0	20 4½ 0			0.35 0.08 0	1.74 0.32 0			3.47	5.86			57 38 43 34 23	74 48 54 42 23		
	11 1 0				0.35 0.03 0				2.02				53 32 35½ 28½ 11			
	11 1¾ 0	20 1½ 0	20 3 0		0.46 0.06 0	0.46 0.05 0	1.74 0.18 0		1.18	3.20	9.06		59 34 38 30 19	53 33 37 29 11	74 40 46 35 11	
	23 5½ 0				1.21 0.27 0				1.63				66 43 48 38 24			
	26 10½ 0	26 8 0			2.04 0.70 0	2.04 0.48 0			1.51	3.14			77 54 63 45 33	77 48½ 55 42 24		
	20 8 0				2.30 0.59 0				2.39				69 59 68 50 40			
7.513 3.680 1.065	29 7¾ 0	29 8 0	29 8 0	29 5½ 0	2.28 0.66 0	2.30 0.63 0	2.30 0.55 0	2.30 0.37 0	4.13	6.52	9.66	18.72	53 62½ 71 54 42	59 63 70 52 40	59 55½ 62 47 24	59 48 54 4 11

condense en liquide qu'on observe dans le cas cité." Now, I must confess, that the expression which I have adopted, (although I am far from wishing to maintain that it is the very best that might have been selected,) appears to me at least as correct as that which my critics propose to substitute; for, considering that it is but a mathematical line which divides the point at which vapour begins to exist, from the point at which it begins to condense, he must have microscopic eyes indeed that can discern the division; and supposing the "*température destructive* de la vapeur," to be accurately represented by 60° of the thermometric scale, he will be an accurate mathematician indeed who will represent the "*température constituante*" by any nearer sign.

And now, expressing my acknowledgments to the Genevese philosophers for their admission of my new instrument, "peut fournir au physician qui le possède, le désir et les moyens de l'employer, tant à la démonstration des principaux phénomènes de l'évaporation, qu'à l'étude plus approfondie des singulières et importantes modifications de la vapeur aqueuse, considérée dans l'air et dans le vide," I shall proceed to contribute my endeavours for the accomplishment of this desirable purpose.

The annexed Table shows at one view the principal results of the twelve-month's experiments, divided for the facility of comparison into periods of half-years, quarters, and half-quarters. It will be easily understood from inspection, and will require but little explanation. The means of the different periods are represented by the larger figures, and the extremes by the smaller, shewing the range of the several instruments in the respective intervals.

It may be observed, that the barometric results of the first quarter do not exactly correspond with those already published in the *Journal.* This is owing to a correction which I have applied in consequence of a defect in the first barometer which I employed. I have since made use of a very excellent instrument of large dimensions of the syphon form, with which I compare all others that I have occasion to employ.

The correction alluded to amounts to +0.1 inches. It may also be remarked, that the calculated means do not rigorously correspond with each other: this is in consequence of the decimal calculations having been carried on further in some instances than others; and fractions, which it was necessary to leave out of the shorter periods, have become appreciable in the longer, the means of the latter having been taken from the whole series of experiments, and not from the means of the former.

The use of the Table will be perhaps better understood from the following comparison of the quarters. Beginning with the three months, December, January, and February, it will be observed, that the mean of the barometer during that period was at its lowest, while its range was greatest. The quantity and pressure of vapour least, and the variation also least. The degree of dryness and rate of evaporation were likewise both at their minimum. The quantity of rain nearly the smallest. The temperature lowest, and the range of the thermometer least. During the quarter comprising the three months of June, July, and August, on the contrary, the mean of the barometer was at its highest, and its range was least,—the quantity and pressure of the vapour was greatest,—the degree of dryness greatest,—rate of evaporation greatest,—and quantity of rain greatest. The mean temperature was also at a maximum. It may farther be remarked, that the mean of these two extreme quarters is nearly the mean in all respects of the whole year.

The intermediate quarters, March, April, and May, and September, October, and November, vary respectively very little from the annual mean. The autumn, however, is marked by more vapour, more rain and a less degree of dryness than the spring, and it is during this period that the range of the thermometer is greatest.

From the average of the whole year we find that the degree of dryness in the afternoon exceeds that of ten o'clock in the morning by $1\frac{1}{2}^{\circ}$, while the degree of dryness of the night falls short of the same by 4°. The evaporation of morning, noon,

and night, are respectively as 41 — 52 — 8, and the weight of vapour in the space of a cubic foot is less at night by 0.07 gr. than in the afternoon*.

For the sake of comparison, I have selected five periods, during which I have been enabled to try experiments contemporaneous with those in London, at a distance of twenty miles in the country. It would be tedious to give the comparison at length, I shall therefore only state the mean results.

The constant difference of the barometer between the two places was 0.09 lower in the country.

		Temper.	Vapour.	Dryness.
Mar. 31st, to April 6th, 7 days,	London,	52½	45	7½
	Country,	53	44	9
May 21st, to 31st, 11 days,	London,	58	50	8
	Country,	59	52	7
June 12th, to June 19th, 8 days,	London,	58½	50	8½
	Country,	52	45½	6½
Aug. 5th, to Aug. 7th, 3 days,	London,	63½	54½	9
	Country,	60½	56½	4
Aug. 26th, to Aug. 28th, 3 days,	London,	57½	52	5½
	Country,	56½	52½	7½

It will be seen from this table that the mean quantities of vapour at these two stations, during these periods, corresponded within a fraction of a degree, too small to name.

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* The editors of the *Bibliothèque Universelle* object to me, that I appear to have been guided by no consideration in the selection of the periods of the day for the performance of my experiments. But obliged as I have been to snatch a few moments from other avocations, it was necessary to consider at what times I should be least likely to meet with interruption so as to be able to continue the series in a regular manner. If I have not chosen quite the most proper periods, (and that I have not I am most willing to allow,) the want of academic leisure must plead my excuse; and I only trust that those who are fortunate enough to have it in their power to devote their whole time to the pursuits of science, and who have more ability for the task, will complete the plan which I have only been enabled to trace.

My opportunities of trying experiments upon heights have still been very limited; so limited, indeed, that I dare not attempt to draw any inferences from their results. I shall content myself, therefore, with noting the particulars of the few that have been within my power.

On the 3d of April I had an opportunity of ascending Leithhill, in Surrey, which is about 800 feet above the level of the valley of Mickleham, the place from whence I set out. The barometer, at the lower station, stood at 30.296, the hygrometer denoted the temperature of the air 60°, and the point of deposition 51°. On the top of the hill the barometer stood at 29.406, and the hygrometer marked 55° and 46°; making a difference in the pressure of the whole atmosphere of 0.890, and in the pressure of the vapour 0.060.

On the 22d May, I again ascended the same hill.

Barometer at first station	30.178	Hygrometer..	71-56
second station	29.348	————..	66-47
Difference of barometric pressure			0.830
Ditto of hygrometric ditto			0.119

A third time, on the 14th of August.

Barometer at first station	29.948	Hygrometer..	72-61
second station	29.055	————..	70-52
Difference of barometric pressure			0.893
Ditto of hygrometric ditto.....			0.141

On the 4th of April I ascended to the highest point of Hedley-heath, a hill in the same vicinity, about 600 feet above the valley.

Barometer at first station	30.050	Hygrometer	58-34
at second station	29.370	————	59-32
Difference of barometric pressure			0.680
Ditto of hygrometric ditto			0.014

On the 7th April the same stations gave as follows:

Barometer at first station	29-582	Hygrometer	46-34
at second station....	28.964	————	44-31
Difference of barometric pressure			0.618
Ditto of hygrometric ditto.....			0.021

These results, it will be seen, are too discordant, and the differences are too small, to throw any light upon the laws of the decrease of the aqueous atmosphere at different elevations, a point of the highest interest and importance. We learn, however from them that, in settled weather, such as that in which these last experiments were made, the vapour does decrease in density as we ascend. In showery weather, however, this is not always the case, for I have seen several instances, when there has been denser vapour upon the hill-top than in the plain below, a state of circumstances which, as far as I have been able to observe, has always been quickly followed by falling weather.

I shall now conclude these observations with a series of experiments, which I took the opportunity of making during the great eclipse on the 7th September, for the purpose of ascertaining what effect this rare phænomenon might have upon the temperature and pressure of the gaseous atmosphere in general, and of the aqueous atmosphere in particular. It had been remarked at Edinburgh, that, during the great eclipse of 18th February, 1736-7, it was very cold, and that a little thin snow fell, and it was not unreasonable to suppose that a sudden obscuration of so large a portion of the sun's rays might produce a very sensible change in the state of the atmospheric vapour.

The day was altogether very favourable to the purpose; the morning was hazy, and there were a few cirri; the wind was S.E., and brisk. The following observations were made previous to the commencement of the eclipse:

Clock.	Thermometer.	Dew Point.	Barometer.
$10\frac{3}{4}$	65	51	30.12
$11\frac{1}{4}$	65	51	
$11\frac{3}{4}$	68	51	
$12\frac{1}{4}$	$67\frac{1}{2}$	51	

Very shortly after the commencement it was observed that the wind died away to a calm, and the smoke drove from the S.W., with a great tendency to beat down. The clouds increased rapidly round the sun, assuming the form of cirro-cumuli, the haze at the same time became more dense. They continued to increase, and at intervals totally obscured the view, till about fifty minutes past one, when they began to dissolve, and at 20 minutes past two the sun was again perfectly clear, and remained so till the end. The barometer, as far as I could judge, was unusually steady during the whole time. The observations were continued every quarter of an hour, as follow:

Clock.	Thermometer.	Dew Point.
12½	67½	51
12¾	67½	51
1	66	52
1¼	65	51
1½	64	50
1¾	64	50
2	63½	53
2¼	63	52
2½	63	51
2¾	63½	52
3	64½	52
3¼	65	52
5	65	52

Thus it appears that there was a depression of temperature amounting to 5°, the maximum of which was 25 minutes, after the greatest obscuration. There was also a sensible vacillation of the point of precipitation; but whether this, and the momentary increase of the clouds, were occasioned by an accidental shift of the wind, or whether all were dependent upon the change of temperature, consequent to the obscurations of the sun's light, may be matter of some doubt. The change of the wind was permanent, and at eleven o'clock at night the constituent tem-

perature of the vapour had risen to 55°, the barometer still continuing at 30.12.

Towards the end of the eclipse, when the disc of the sun was quite free from clouds, I had a good experiment upon the power of the sun's rays. I directed, upon some gun-powder, the focus of a small lens, which had very little more than sufficient power to ignite it in clear sunshine; it was exactly at three-quarters past two that it took fire, 55 minutes from the greatest obscuration, and thirty-two minutes before the end of the eclipse. This effect would appear to be very much greater than the corresponding one produced upon the thermometer; and I could not but observe that the impression upon the feeling was likewise much more than would have been expected from the fall in that instrument. This latter sensation was probably owing to the great increase in the radiation of the body, as was the former effect to the decrease of absorption, both surfaces being instantly sensible to the diminution of the sun's energy, while the air only felt the influence of bodies which had been primarily affected *.

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* A practical illustration of the unfitness of hygroscopic substances for the construction of accurate instruments, may be found in the *Annals of Philosophy* for the last month. It consists of the following memorandum, appended to the Meteorological Journal, so accurately and ably kept by Mr. Howard.

" The mean of the hygrometer is, for the latter seventeen days of the month, 79.35, but the mean deduced for the like space, from a new one now substituted for it, is 64.88 ; it appears, therefore, that the old one, the inaccuracy of which has been heretofore stated, will require a deduction of fourteen degrees from its later results. It appears to have been employed from about midsummer, 1819, and the error, which has apparently arisen from the stretching of a too slender piece of whalebone, has probably increased from that time to the present."

METEOROLOGICAL JOURNAL—*continued from Vol.* IX., *page* 277.

Date. 1820.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
June 1	10		29.60	....	0.351	56	48	8	3.884	3.940	5.068	..	..	....	1.22	..	45	0.68	NW	stormy	stratus and scud	Heavy showers.
	4		29.60	....	0.263	57	40	17	2.905	2.999	5.235	60	..	....	....	..	..	1.33	W	high	ditto ditto	Clearing—fine.
	10		29.61	....	0.294	51	43	8	3.274	3.326	4.330	..	47	42	....	..	44	0.48	....	brisk	ditto ditto	Overcast.
2	10		29.62	....	0.305	56	44	12	3.375	3.452	5.068	..	..	....	0.32	..	45	0.78	....	ditto	cumuli	Fine—but threatening.
	4		29.65	....	0.375	58	50	8	4.135	4.195	5.402	60	..	....	....	..	..	0.46	....	little	ditto cirri	Some showers—fine.
	10	☽	29.71	...	0.339	50	47	3	3.791	3.815	4.195	..	42	32	....	..	45	0.14	....	calm	nimbi and ditto	Fine.
3	10		29.80	....	0.351	50	48	2	3.926	3.940	4.195	..	..	....	....	..	45	0.10	....	ditto	stratus	Gentle rain.
	4		29.84	....	0.401	56	52	4	4.436	4.468	5.068	56	..	....	....	..	..	0.23	....	little	ditto	Hard rain.
	10		29.89	....	0.328	50	46	4	3.669	3.699	4.195	..	46	41	0.07	..	48	0.19	....	ditto	ditto and cumuli	Overcast.
4	10		29.95	....	0.294	51	43	8	3.275	3.326	4.330	..	..	....	....	.	47	0.37	NW	little	cumuli and nimbi	A few drops of rain.
	4		29.95	....	0.316	51	45	6	3.528	3.570	4.330	55	..	....	0.01	..	..	0.29	....	calm	ditto ditto	Ditto ditto.
	10		29.99	....	0.316	48	45	3	3.547	3.570	3.940	..	40	30	....	..	48	0.14	....	ditto	ditto ditto	Gloomy and overcast.
5	10		30.01	....	0.328	56	46	10	3.629	3.699	5.068	..	..	....	....	..	48	0.52	W	little	cumulo-strati	Dull morning.
	4		30.01	+ 0.41	0.388	66	51	15	4.212	4.330	6.912	66	..	.. ..	....	..	..	0.99	....	ditto	ditto and stratus	Threatening.
	11		29.93	....	0.458	59	56	3	5.073	5.068	5.570	..	47	47	....	..	48	0.20	....	ditto	dark and overcast	Incessant rain from eight o'clock.
6	10		29.88	— 0.13	0.375	52	50	2	4.176	4.195	4.468	..	..	....	0.25	..	48	0.14	W	brisk	stratus and scud	Small rain.
	4		30.02	....	0.458	56	56	..	5.068	....	....	59	..	....	....	..	..	. ..	....	little	ditto ditto	Showers and very dull,
	11		30.13	+ 0.25	0.316	49	45	4	3.541	3.570	4.068	.	42	34	.. .	..	47	0.19	N	ditto	none	Fine, but stars—dull.
7	10		30.08	....	0.339	59	47	12	3.727	3.815	5.570	..	..	....	....	..	50	0.67	NW	ditto	cumuli and stratus	Rather heavy.
	5		30.05	....	0.328	61	46	15	3.594	3.699	5.950	63	..	....	....	..	..	0.86	....	ditto	ditto ditto	Dull—but clearer.
	11		30.03	....	0.316	50	46	5	3.535	3.570	4.195	..	46	39	....	..	49	0.24	N	ditto	ditto ditto	Few stars—clear in the N.
8	10		29.97	....	0.415	62	53	9	4.538	4.616	6.126	..	..	....	....	..	49	0.58	NW	little	cumulo-strati	Overcast and dull.
	5		29.94	....	0.443	65	55	10	4.826	4.910	6.614	63	..	....	....	..	..	0.69	....	ditto	ditto	Ditto ditto—showers.
	11		29.87	....	0.443	58	55	3	4.884	4.910	5.402	.	54	52	....	..	51	0.19	. ..	ditto	ditto	Ditto ditto.
9	10		29.83	....	0.443	60	55	5	4.862	4.910	5.761	..	..	....	....	..	51	0.33	....	ditto	ditto and stratus	Ditto ditto ditto,
	5		29.74	....	0.443	61	55	6	4.854	4.910	5.950	66	..	....	0.06	..	..	0.40	....	ditto	ditto ditto	Ditto ditto ditto.
	11		29.73	— 0.40	0.339	50	47	3	3 791	3.815	4.195	..	41	33	....	..	50	0.14	....	ditto	ditto ditto	Ditto ditto
10	10		29.77	....	0.339	63	47	16	3.700	3.815	6.310	..	..	....	....	..	50	0.95	...	ditto	ditto ditto	Ditto ditto
	5	●	29.79	+ 0.06	0.273	60	41	19	2.995	3.106	5.761	63	..	....	....	..	..	1.30	....	brisk	ditto ditto and cirrus	Ditto ditto
	10		29.75	....	0.316	50	45	5	3.535	3.570	4.195	..	41	33	....	..	51	0.24	....	little	none	Very fine.
11	10		29.66	....	0.294	53	43	10	3.263	3.326	4.616	..	..	....	....	..	50	0.62	....	brisk	stratus and scud	Dull.
	5		29.62	— 0.17	0.401	54	52	2	4.452	4.468	4.770	61	..	....	0.02	..	..	0.11	SW	little	ditto ditto	Hard rain.
	10		29.63	....	0.375	50	50	..	4.195	....	....	..	48	....	.. ..	..	52	....	....	ditto	ditto ditto	Ditto ditto—dull.
12	10		29.78	....	0.401	58	52	6	4.420	4.468	5.402	..	..	.. ..	0.03	..	53	0.36	N	little	cumulo-strati	Fine, but not clear.
	4		29.85	....	0.375	63	50	13	4.095	4.195	6.310	64	..	....	....	..	..	1.06	....	brisk	cumuli and ditto	Fine.
	10		29.93	....	0.339	50	47	3	3.791	3.815	4.195	..	40	30	...	..	53	0.14	....	little	none	Clear starlight.
13	10		29 94	+ 0.32	0.388	58	51	7	4.276	4.330	5.402	..	..	....	....	..	55	0.41	NW	ditto	cumulo-strati	Much blue sky, but not clear.
	4		29.91	— 0.03	0.458	57	56	1	5.059	5.068	5.235	61	..	....	0.63	..	..	0.07	....	ditto	cumuli and nimbi	Very heavy rain, and thunder.

	10		29.96	....	0.388	51	51	..	4.330	....	....	..	45	40	....	..	54	....	....	ditto	cumuli and nimbi	Very threatening.
June 14	10		30.19	+0.28	0.375	54	50	4	4.164	4.195	4.770	..	..	....	....	..	55	0.21	....	ditto	cumulo-strati and stratus	Dark and dull.
	4		30.12	....	0.363	59	49	10	3.992	4.068	5.570	59	..	....	....	..	..	0.58	....	ditto	ditto ditto	Ditto ditto.
	11		30.04	....	0.375	53	50	3	4.172	4.195	4.616	..	48	31	....	..	54	0.11	....	ditto	ditto ditto	Ditto—gentle rain.
15	10		29.88	−0.31	0.429	60	54	6	4.715	4.770	5.761	..	..	....	....	..	54	0.39	....	ditto	cirro-cumuli, cumuli & nimbi	Overcast.
	4		29.96	....	0.401	59	52	7	4.408	4.468	5.570	63	..	....	....	..	..	0.43	....	ditto	ditto ditto	Ditto and very dark.
	10		30.00	....	0.339	49	47	2	3.798	3.815	4.068	..	51	44	....	..	54	0.09	....	calm	stratus in the horizon	Moon clear.
16	10		30.01	+0.13	0.363	61	49	12	3.978	4.068	5.950	..	..	....	....	..	55	0.72	W	little	cumuli and cirri	Fine.
	5		29.99	....	0.388	67	51	16	4.205	4.330	7.013	69	..	....	....	..	..	1.07	....	ditto	ditto ditto	Ditto.
	10		29.98	−0.03	0.429	58	54	4	4.736	4.770	5.402	..	48	40	....	..	55	0.25	....	calm	cumulo-strati	Ditto.
17	10		30.01	....	0.363	62	49	13	3.971	4.068	6.126	..	..	....	....	..	54	0.79	NW	little	cumuli and cirri	Dull—but fine.
	5		30.01	....	0.388	67	51	16	4.205	4.330	7.013	69	..	....	....	..	..	1.07	....	ditto	ditto and cumulo-strati	Ditto ditto.
	10		30.05	....	0.429	58	54	4	4.736	4.770	5.402	..	48	40	....	..	53	0.25	....	calm	ditto ditto	Clouds breaking.
18	10		30.11	+0.13	0.328	62	46	16	3.585	3.699	6.126	..	..	....	....	..	57	0.93	....	little	ditto ditto	Very cloudy.
	4	☾	30.05	....	0.363	67	49	18	3.936	4.068	7.013	68	..	....	0.54	..	..	2.01	....	brisk	ditto ditto	Dull—with little sun.
	10		29.95	....	0.388	57	51	6	4.284	4.330	5.235	..	53	50	....	..	51	0.35	SW	little	ditto ditto	Threatening and dull.
19	10		29.79	−0.32	0.388	63	51	12	4.234	4.330	6.310	..	..	....	....	..	57	0.99	NW	brisk	ditto ditto	Fine, but cloudy.
	5		29.80	....	0.351	63	48	15	3.832	3.940	6.310	67	..	....	0.09	..	..	1.18	....	ditto	ditto ditto	Ditto ditto.
	11		29.80	+0.01	0.305	53	44	9	3.393	3.452	4.616	..	49	44	....	..	51	0.69	....	high	ditto ditto	Ditto ditto.
20	10		29.71	−0.09	0.388	56	51	5	4.291	4.330	5.068	..	..	....	.. ..	..	54	0.36	W	brisk	stratus	Gentle rain.
	5		29.82	....	0.443	61	55	6	4.854	4.910	5.950	63	..	....	....	..	..	0.40	SW	ditto	ditto and cumulo-stratus	Showery.
	10		29.87	....	0.401	54	52	2	4.452	4.468	4.770	..	45	36	....	..	54	0.11	NW	calm	ditto ditto	Ditto.
21	10		29.92	....	0.375	62	50	12	4.103	4.195	6.126	..	..	....	0.08	..	54	0.96	....	brisk	cumuli	Very fine.
	4		29.99	....	0.429	66	54	12	4.665	4.770	6.912	68	..	....	....	..	..	0.83	....	little	cumulo-strati	Ditto ditto.
	11		30.03	....	0.388	52	51	1	4.319	4.330	4.468	..	46	38	....	..	52	0.05	....	calm	cirri	Ditto—much dew.
22	9		30.09	....	0.458	62	56	6	5.010	5.068	6.126	..	..	....	....	..	55	0.41	SW	little	stratus and haze	Very misty.
	4		30.10	....	0.474	75	57	18	5.063	5.235	9.091	76	..	....	....	..	..	1.59	....	ditto	ditto ditto	Hazy—sunshine—very close.
	11		30.12	....	0.507	60	59	1	5.565	5.570	5.761	..	51	40	....	..	55	0.07	....	calm	ditto ditto	Moon hazy.
23	10		30.20	....	0.474	66	57	9	5.147	5.235	6.912	..	..	....	....	..	55	0.64	W	gentle	cum.-strati&cirro-cum.&cir.	Very fine.
	4		30.20	....	0.578	77	63	14	6.153	6.310	9.688	79	..	....	....	..	..	1.34	SW	calm	cirri	Beautifully clear.
	10		30.23	....	0.524	65	60	5	5.710	5.761	6.614	..	56	46	....	..	56	0.36	....	ditto	none	Perfectly fine.
24	10		30.27	....	0.524	74	60	14	5.616	5.761	8.807	..	..	....	....	..	55	1.19	S	little	few cumuli	Very fine.
	4		30.29	....	0.616	84	65	19	6.389	6.614	11.981	85	..	....	....	..	..	2.10	NW	calm	none	Perfectly fine.
	11		30.33	....	0.542	68	61	7	5.877	5.950	7.316	..	60	55	....	..	52	0.53	....	ditto	none	Ditto ditto.
25	10		30.40	....	0.560	77	62	15	5.963	6.126	9.688	..	..	....	....	..	52	1.41	SE	ditto	none	Ditto ditto.
	4		30.40	....	0.655	87	67	20	6.763	7.013	12.966	87	..	....	....	..	..	2.30	N	ditto	cirri	Ditto ditto.
	10		30.43	....	0.578	73	63	10	6.915	6.310	8.533	..	63	53	....	..	52	0.87	W	ditto	ditto	Ditto ditto.
26	10	●	30.44	+0.73	0.655	81	67	14	6.838	7.013	10.993	..	..	....	....	..	53	1.54	NW	little	ditto	Ditto ditto.
	4		30.43	−0.01	0.721	89	70	19	7.513	7.776	13.756	89	..	....	....	..	..	2.28	....	calm	none	Ditto ditto.
	11		30.44	....	0.542	69	61	8	5.866	5.950	7.541	..	62	52	....	..	51	0.62	NE	ditto	none	Ditto ditto.
27	10		30.44	....	0.635	79	66	13	6.753	6.912	10.292	..	..	....	....	..	52	1.34	....	little	cirro-cumuli	Very fine.
	5		30.46	+0.03	0.721	83	70	13	7.599	7.776	11.590	86	..	....	....	..	..	1.52	NE	ditto	cumulo-strati	Very fine—oppressive.
	11		30.34	....	0.655	69	67	2	6.988	7.013	7.541	..	68	59	....	..	54	0.17	....	calm	none	Ditto ditto.
28	10		30.33	....	0.655	85	67	18	6.787	7.013	12.252	..	..	....	....	..	51	2.06	W	ditto	haze	Ditto ditto.
	5		30.24	....	0.597	84	64	20	6.274	6.506	11.980	85	..	....	....	..	..	2.17	NE	ditto	cirri	Very fine.
	11		30.23	....	0.560	69	62	7	6.051	6.126	7.541	..	59	56	....	..	53	0.71	....	brisk	cirro-strati	Ditto ditto. [3 hours 4 o'clock.
29	10		30.19	....	0.524	65	60	5	5.710	5.761	6.614	..	..	....	....	..	53	0.46	SE	ditto	stratus and haze	Cool and fresh—hard rain 4 miles from London, for
	4		30.06	....	0.578	71	63	8	6.222	6.310	8.027	73	..	....	....	..	..	0.85	....	ditto	cirro-strati and haze	Very fine.
	11		30.03	....	0.490	58	58	..	5.402	....	....	..	56	53	....	..	53	....	....	ditto	stratus	Summer lightning—hard rain in the night.
30	10		29.99	....	0.560	65	62	3	6.093	6.126	6.614	..	..	....	.. .	..	54	0.35	E	high	ditto and cumulo-stratus	Overcast—some rain.
	3		29.94	−0.52	0.524	62	60	2	5.740	5.761	6.126	70	..	....	....	..	..	0.22	....	ditto	ditto ditto	Overcast.
	10		30.09	....	0.401	55	52	3	4.444	4.468	4.910	..	50	45	....	..	52	0.22	....	brisk	ditto ditto	Ditto and colder.
July 1	9		30.21	....	0.339	61	47	14	3.713	3.815	5.950	..	..	....	....	..	52	1.04	....	ditto	cumulo-strati	Very fine and fresh.
	4		30.28	....	0.363	62	49	13	3.971	4.068	6.126	67	..	....	....	..	..	0.79	NE	little	ditto	Fine.
	10		30.30	+0.36	0.339	53	47	6	3.770	3.815	4.616	..	44	37	....	..	53	0.30	....	calm	ditto	Ditto—stars dim.
2	10	☽	30.19	....	0.401	62	52	10	4.385	4.468	6.126	..	..	....	0.16	..	54	0.64	W	little	stratus	A few drops of rain.
	4		30.09	....	0.490	60	58	2	5.378	5.402	5.761	68	..	....	....	..	..	0.14	SW	ditto	ditto and scud	Hard rain.
	10		30.06	....	0.363	52	49	3	4.042	4.068	4.468	..	45	40	....	..	54	0.15	....	ditto	stratus	Clouds breaking.
3	10		30.00	....	0.388	60	51	9	4.256	4.330	5.761	..	..	....	....	..	54	0.55	....	ditto	ditto	Hard showers.
	6		29.89	−0.41	0.474	60	57	3	5.203	5.235	5.761	66	..	....	0.12	..	..	0.20	NW	little	cumulo-strati	Showery.
	10		29.91	....	0.443	55	55	..	4.910	4.910	4.91	..	52	49	....	..	53	....	....	ditto	ditto	Overcast and damp.

METEOROLOGICAL JOURNAL—*continued.*

Date. 1820.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs., from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
July 4	9		29.97	....	0.401	61	52	9	4.393	4.468	5.950	..	..	....	....	..	52	0.57	NE	little	cumuli & cumulo-strati	Fine—clouds heavy.
	5		30.01	....	0.328	60	46	14	3.600	3.699	5.761	70	..	....	....	..	..	0.79	....	ditto	cumulo-strati	Fine.
	11		30.05	....	0.388	54	51	3	4.308	4.330	4.770	..	53	45	....	..	52	0.16	....	calm	overcast	Dull.
5	9		30.12	+0.23	0.339	60	47	13	3.720	3.815	5.761	..	..	....	....	..	50	0.74	NE	little	cumulo-strati	Fine.
	5		30.11	−0.01	0.363	58	49	9	4.002	4.068	5.402	61	..	....	....	..	..	0.51	....	ditto	ditto	Dull all day.
	10		30.14	....	0.351	51	48	3	3.919	3.940	4.330	..	48	39	....	..	50	0.15	....	calm	none	Very fine—stars bright.
6	8		30.17	+0.06	0.375	58	50	8	4.135	4.195	5.402	..	..	....	....	..	52	0.46	....	little	cumulo-strati	Very fine.
	5		30.14	−0.03	0.401	62	52	10	4.361	4.468	6.126	64	..	....	....	..	..	0.82	....	brisk	ditto	Fine, but cloudy.
	11		30.16	+0.02	0.429	55	54	1	4.761	4.770	4.910	..	52	45	....	..	53	0.06	....	calm	ditto	Ditto ditto.
7	9		30.13	−0.03	0.401	59	52	7	4.404	4.468	5.570	..	..	....	....	..	53	0.43	....	little	ditto	Ditto ditto.
	5		30.16	....	0.415	64	53	11	4.522	4.616	6.506	65	..	....	....	..	..	0.73	N	ditto	ditto	Ditto ditto
	11		30.19	+0.06	0.375	55	50	5	4.157	4.195	4.910	..	53	47	....	..	52	0.27	....	calm	overcast	Few—stars and dull.
8	10		30.18	....	0.351	58	48	10	3.870	3.940	5.402	..	..	....	....	..	51	0.56	NE	little	cumulo-stratus and haze	Overcast and fine.
	5		30.17	−0.02	0.339	59	47	12	3.723	3.815	5.570	62	..	....	....	..	..	0.67	....	ditto	ditto ditto	Ditto ditto.
	11		30.19	....	0.351	58	48	7	3.891	3.940	4.910	..	52	50	....	..	52	0.37	....	ditto	overcast	Very dull.
9	10		30.19	+0.02	0.388	60	51	9	4.257	4.330	5.761	..	..	....	....	..	52	0.55	E	calm	stratus&cum.-stratushaze	Overcast, but fine.
	5		30.15	−0.04	0.443	62	55	7	4.845	4.910	6.126	65	..	....	....	..	..	0.47	....	little	ditto ditto	Overcast and dull.
	11		30.16	+0.01	0.443	57	55	2	4.893	4.910	5.235	..	54	50	....	..	52	0.13	....	ditto	ditto ditto	Ditto ditto, gleams of heat.
10	10	●	30.14	...	0.375	61	50	11	4.109	4.195	5.950	..	..	....	....	..	53	0.67	SE	calm	cumulo-stratus and haze	Overcast, but fine.
	5		30.10	....	0.401	64	52	12	4.371	4.468	6.506	68	..	....	....	..	..	0.79	....	little	ditto ditto	Fine and warmer.
	11		30.09	−0.07	0.388	55	51	4	4.301	4.330	4.910	..	50	44	....	..	52	0.22	....	calm	none	Stars very bright.
11	10		30.10	+0.01	0.401	65	52	13	4.362	4.468	6.614	..	..	....	....	..	51	0.85	E	little	cirro-strati and haze	Fine—dim sunshine.
	4		30.01	...	0.443	66	55	11	4.811	4.910	6.912	67	..	....	....	..	..	0.77	....	ditto	cumulo-strati and haze	Hazy sunshine.
	11		30.01	....	0.429	56	54	2	4.753	4.770	5.068	..	50	44	....	..	53	0.12	....	ditto	cirri	Very fine.
12	10		29.96	....	0.443	62	55	7	4.845	4.910	6.126	..	..	....	....	..	53	0.47	....	ditto	cumulo-strati	Overcast, but fine.
	4		29.88	....	0.443	64	55	9	4.828	4.910	6.506	67	..	....	....	..	..	0.79	....	brisk	ditto and stratus	Ditto ditto.
	11		29.86	.. :	0.443	57	55	2	4.893	4.910	5.235	..	52	52	....	..	52	0.15	....	ditto	overcast	Very dull and close.
13	10		29.83	−0.17	0.429	61	54	7	4.707	4.770	5.950	..	..	....	....	..	52	0.59	....	ditto	cumulo-strati	Overcast and dull.
	5		29.84	... .	0.415	61	53	8	4.546	4.616	5.950	63	..	....	....	..	..	0.66	....	ditto	ditto ditto	Ditto ditto.
	11		29.85	....	0.401	55	52	3	4.444	4.468	4.910	..	52	49	....	..	51	0.22	....	ditto	ditto ditto	Ditto ditto.
14	10		29.87	....	0.474	65	57	8	5.157	5.235	6.614	..	..	....	....	..	52	0.73	....	ditto	ditto heavy	Fine—sun at intervals.
	4		29.90	.. .	0.507	68	59	9	5.487	5.570	7.316	69	..	....	....	..	..	0.67	SE	calm	ditto	Ditto ditto.
	11		29.92	....	0.542	62	61	1	5.940	5.950	6.126	..	59	57	....	..	55	00.7	....	ditto	overcast	Very oppressive, some drops of rain.
15	10		29.97	....	0.524	65	60	5	5.710	5.761	6.614	..	..	....	....	..	59	0.36	SW	calm	mist and stratus	Overcast and oppressive.
	4		30.00	. ..	0.578	73	63	10	6.195	6.310	8.533	78	..	....	....	..	..	0.87	....	little	cumuli and cirri	Fine.
	10		30.03	+0.20	0.524	61	60	1	5.751	5.761	5.950	..	53	45	....	..	55	00.7	....	calm	none	Clear star-light.
16	10		29.99	....	0.560	72	62	10	6.014	6.126	8.270	..	..	....	....	..	58	1.08	W	brisk	stratus	Very dark.
	5		29.96	....	0.688	75	67	8	6.910	7.013	9.091	76	..	....	....	..	..	0.59	SE	ditto	ditto and nimbi	Thunder-showers—very oppressive.

	10		29.92	....	0.616	66	65	1	6.601	6.614	6.912	..	60	56	....	..	56	0.08	....	little	overcast	Hot and oppressive.
17	10		29.60	....	0.655	68	67	1	7.001	7.013	7.316	..	..	....	....	..	58	0.40	....	brisk	stratus	Hard rain.
	4		29.56	....	0.635	66	66	..	6.912	....	....	75	..	....	0.20	..	..	....	....	ditto	ditto	Hard rain all day.
	11		29.52	....	0.490	59	58	1	5.387	5.402	5.570	..	54	47	....	..	60	0.07	NW	little	none	Very fine.
18	10		29.40	....	0.542	6.	61	..	5.950	....	....	..	..	....	....	..	60	.. .	W	ditto	stratus	Steady pouring rain.
	4	☾	29.39	−0.64	0.560	62	62	..	6.126	....	.. ..	74	..	....	0.43	..	..	....	SW	little	stratus and scud	Pouring showers.
	11		29.41	....	0.474	57	57	..	5.235	....	....	..	53	48	....	..	59	.. .	....	ditto	ditto ditto	Moon dull—few stars.
19	10		29.45	....	0.521	60	60	9	5.671	5.761	7.541	..	..	....	....	..	60	0.69	W	ditto	cumuli-cirri haze	Very fine and hot.
	4		29.53	....	0.542	61	61	7	5.877	5.950	7.316	72	..	....	0.74	..	..	0.68	....	brisk	ditto ditto and nimbus	Very fine—oppressive—hard showers.
	11		29.61	....	0.507	59	59	..	5.570	....	....	..	55	48	....	..	58	....	....	calm	few—mist	Fine.
20	10		29.69	....	0.524	70	60	10	5.659	5.761	7.776	..	..	....	....	..	59	0.78	....	little	cirri-cumuli, haze	Very fine and hot.
	4		29.72	....	0.524	71	60	11	5.650	5.761	8.027	72	..	....	....	..	..	1.13	....	brisk	ditto ditto ditto	Ditto and very oppressive—thunder shower.
	11		29.81	..	0.542	62	61	1	5.939	5.950	6.126	..	5[illegible]	52	....	..	59	0.07	....	calm	few	Fine—stars bright—showers.
21	10		29.89	....	0.524	63	60	3	5.730	5.761	6.310	..	..	....	....	..	68	0.21	NW	ditto	stratus and mist	Very close and oppressive.
	5		29.91	....	0.524	68	60	8	5.684	5.761	7.316	70	..	....	0.42	..	..	0.60	....	little	cumuli stratus and mist	Shower—very fine.
	11		29.94	....	0.524	62	60	2	5.740	5.761	6.126	..	54	46	....	..	57	0.14	....	calm	overcast	Close and oppressive.
22	10		29.97	....	0.401	70	52	18	4.324	4.468	7.77[illegible]	..	..	.. .	....	..	54	1.64	....	brisk	cumulo-strati	Very fine and exhilarating.
	5		29.97	....	0.401	64	52	12	4.370	4.468	6.506	70	..	....	....	..	..	1.01	. ..	ditto	ditto and cumuli	Overcast.
	10		29.97	....	0.40.	58	52	6	4.420	4.468	5.402	..	54	51	....	..	54	0.36	....	little	overcast	A few drops of rain.
23	10		30.00	....	0.401	58	52	6	4.420	4.468	5.402	..	..	....	....	..	54	0.36	....	ditto	cumuli and cumulo-strati	Fine.
	4		30.00	....	0.420	63	54	9	4.600	4.770	6.310	64	..	....	....	..	..	0.60	....	ditto	ditto ditto	Ditto.
	10		30.02	....	0.415	57	53	4	4.586	4.616	5.235	..	52	46	....	..	54	0.24	....	ditto	ditto ditto	A few drops of rain.
24	10		30.03	....	0.458	65	56	9	4.984	5.068	6.614	..	..	....	....	..	55	0.63	....	ditto	ditto ditto	Fine.
	4		30.01	+0.62	0.542	74	61	13	5.811	5.950	8.807	75	..	....	....	..	..	1.12	....	ditto	ditto ditto	Ditto.
	10		29.90	....	0.507	64	59	5	5.525	5.570	6.506	..	59	55	....	..	56	0.36	....	ditto	ditto ditto	Ditto.
25	10		29.90	−0.11	0.443	69	55	14	4.786	4.910	7.541	..	..	....	....	..	58	1.31	NW	brisk	ditto ditto	Very fine.
	5	○	29.91	....	0.401	65	52	13	4.362	4.468	6.614	73	..	....	....	..	..	1.10	....	brisk	cumuli and cumulo-strati	Fine—light showers.
	11		29.94	....	0.388	57	51	6	4.284	4.330	5.235	..	53	46	....	..	52	0.35	....	little	cumulo-strati	Fine.
26	9		30.05	....	0.388	71	51	20	4.176	4.330	8.027	..	..	....	0.03	..	53	1.84	NW	brisk	cumulo-strati	Very fine.
	5		30.07	....	0.474	71	57	14	5.102	5.235	8.027	75	..	....	....	..	..	1.08	....	little	ditto	Ditto ditto.
	10		30.08	+0.18	0.524	62	60	2	5.741	5.761	6.126	..	61	54	....	..	55	0.14	....	calm	none	Perfectly fine.
27	10		30.06	....	0.542	72	61	11	5.830	5.950	8.270	..	..	....	....	..	57	.91	W	little	cumulo-strati and mist	Very fine and oppressive.
	5		30.01	−0.07	0.542	74	61	13	5.810	5.950	8.807	76	..	....	....	..	..	1.44	....	brisk	ditto ditto	Ditto ditto
	11		30.02	....	0.524	62	60	2	5.741	5.761	6.126	..	58	51	....	..	54	0.14	....	little	cirri	Very fine—moon bright.
28	10		30.07	+0.06	0.542	77	61	16	5.781	5.950	9.688	..	..	....	....	..	57	1.48	....	ditto	cumulo-strati and haze	Very fine and oppressive.
	5		30.03	−0.04	0.542	74	61	13	5.810	5.950	8.807	78	..	....	....	..	..	1.12	....	ditto	ditto ditto and cirri	Ditto ditto.
	11		30.07	....	0.524	64	60	4	5.721	5.761	6.506	..	61	53	....	..	53	0.29	....	ditto	cirro-cumuli	Fine.
29	10		30.10	....	0.524	71	60	11	5.651	5.761	8.027	..	..	....	....	..	54	0.88	....	ditto	light stratus and mist	Fine and oppressive.
	5		30.13	....	0.507	78	59	19	5.388	5.570	9.992	79	..	....	....	..	..	1.73	....	ditto	cumuli	Very fine.
	10		30.13	+0.10	0.524	67	60	7	5.691	5.761	7.013	..	58	47	....	..	55	0.52	....	ditto	ditto	Ditto ditto.
30	10		30.12	....	0.542	73	61	12	5.821	5.950	8.533	..	..	....	....	..	54	1.01	SW	calm	cumuli and haze	Ditto ditto.
	5		30.07	....	0.560	75	62	13	5.983	6.126	9.091	79	..	....	....	..	..	1.16	S	ditto	ditto and nimbi	Clouds very heavy.
	10		29.99	....	0.597	65	64	2	6.483	6.506	6.912	..	58	51	....	..	56	0.15	....	ditto	ditto ditto	Thunder storm—very violent
31	10		29.90	....	0.560	72	62	10	6.014	6.126	8.270	..	..	....	0.41	..	56	0.84	SE	little	cirri and cirro-cumuli	Fine.
	4		29.90	....	0.597	81	64	17	6.312	6.506	10.993	83	..	....	.. ..	..	..	2.28	SW	brisk	ditto ditto	Ditto.
	10		29.89	....	0.635	72	66	6	6.834	6.912	8.270	..	63	57	....	..	55	0.54	....	little	cumulo-strati	Ditto.
Aug. 1	10	☾	29.86	−0.27	0.597	68	59	9	5.487	5.570	7.316	..	..	....	....	..	55	0.86	....	brisk	.....	Ditto.
	5		29.88	....	0.490	72	58	14	5.262	5.402	8.270	74	..	....	.. .	..	..	1.44	W	brisk	cirri and scud	Ditto.
	11		29.99	....	0.542	61	61	..	5.950	....	....	..	58	53	. ..	..	51	....	....	little	few and light	Moon sharp and bright.
2	10		30.12	+0.26	0.443	72	55	17	4.757	4.910	8.270	..	..	....	.. .	..	53	1.31	W	little	cumulo-strati	Very fine—exhilarating.
	5		30.08	....	0.415	71	53	18	4.467	4.616	8.027	76	..	....	....	..	..	1.70	....	brisk	ditto few	Ditto ditto.
	11		30.08	....	0.542	63	61	2	5.929	5.950	6.310	..	62	55	....	..	52	0.14	SE	little	overcast	Dull and close.
3	10		29.99	....	0.635	73	66	7	6.822	6.912	8.533	..	..	....	....	..	56	0.82	SW	brisk	cumulo-strati, strati & haze	Overcast and oppressive.
	3		29.92	....	0.635	72	66	6	6.834	6.912	8.270	76	..	....	....	..	..	0.69	....	ditto	ditto ditto ditto	Dull, and sprinklings of rain.
	10		29.84	....	0.578	66	63	3	6.277	6.310	6.912	..	65	63	....	..	57	0.36	.. .	ditto	stratus and scud	Sprinklings of rain—clearing.
4	10		29.75	−0.37	0.597	71	64	7	6.427	6.506	8.027	..	..	....	....	..	59	1.16	....	ditto	ditto ditto and haze	Hard rain and thunder in the night—fine.
	4		29.82	....	0.597	71	64	7	6.427	6.506	8.027	74	..	....	....	..	..	0.59	....	little	cumuli	Threatening.
	11		29.86	....	0.474	60	57	3	5.203	5.235	5.761	..	53	51	....	..	55	0.20	....	calm	ditto	Smart and short showers.
5	10		29.88	....	0.415	65	53	12	4.514	4.616	6.614	..	..	....	0.70	..	54	1.03	....	brisk	ditto	Fine.
	4		29.90	....	0.415	68	53	12	4.491	4.616	7.316	71	..	....	....	..	..	1.63	....	high	ditto and stratus	Beautifully clear.
	11		29.92	+0.17	0.474	59	57	2	5.211	5.235	5.570	..	57	55	....	..	55	0.43	....	calm	ditto ditto	Hard rain—dark.

METEOROLOGICAL JOURNAL—*continued.*

Date. 1820.	Hour.	Moon's Age.	Pressure. Of the whole Atmosphere.	Pressure. Continuous rise and fall of Barometer.	Pressure. Of the Vapour.	Temperature. Of the Air.	Temperature. Of the Vapour.	Temperature. Difference.	Weight in grs. of Vapour in the space of a cubic foot. As expanded by the existing temperature.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Vapour.	Weight in grs. of Vapour in the space of a cubic foot. Maximum at the temperature of the Air.	Temperature. Highest.	Temperature. Lowest.	Temperature. Of a good radiator on the ground.	Quantity of rain.	De Luc's Hygrometer. Dry.	De Luc's Hygrometer. Moist.	Force of evaporation in grs. from a surface 6 ins. diameter.	WIND. Direction.	WIND. Force.	PREVAILING CLOUDS.	OBSERVATIONS.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22
Aug. 6.	10		29.74	....	0.401	68	52	16	4.339	4.468	7.316	..	.	..	..	..	59	1.73	SW	brisk	cirro-cumuli & cumulo-strat.	Very fine.
	4		29.65	— 0.27	0.507	68	59	9	5.487	5.570	7.316	68	..	..	0.11	..	..	1.05	....	high	ditto and stratus	Incessant rain.
	10		29.67	....	0.474	59	57	2	5.211	5.235	5.570	..	56	52	..	..	55	0.21	....	ditto	ditto ditto	Showers—clearing.
7	10		29.80	....	0.458	65	56	9	4.984	5.068	6.614	..	..	..	0.12	..	55	0.81	W	brisk	ditto ditto	Fine.
	4		29.94	....	0.415	67	53	14	4.498	4.616	7.013	70	..	..	..	..	..	0.96	....	little	cumuli and ditto	Ditto, but overcast.
	10		30.00	....	0.388	56	51	5	4.291	4.330	5.068	..	49	41	..	..	53	0.28	....	calm	ditto ditto	Ditto—stars dim.
8	10		30.02	+ 0.37	0.429	66	54	12	4.665	4.770	6.912	..	..	..	..	..	55	1.07	....	brisk	cirri and cirro-strati	Fine.
	5	●	29.88	....	0.401	68	52	16	4.339	4.468	7.316	69	..	..	..	..	..	1.41	SW	ditto	cirro-cumuli & cumulo-strat.	Very fine and fresh.
	11		29.83	— 0.19	0.443	61	55	6	4.853	4.910	5.950	..	58	51	..	..	53	0.63	....	high	overcast	Dull.
9	10		29.97	....	0.415	72	53	19	4.455	4.616	8.270	..	..	..	..	..	55	1.83	W	brisk	cumulo-strati	Very fine.
	5		30.05	....	0.388	71	51	20	4.175	4.330	8.027	73	..	..	..	..	..	1.84	....	ditto	none	Perfectly fine—exhilarating.
	11		30.15	....	0.388	58	51	7	4.276	4.330	5.402	..	54	47	..	..	53	0.41	....	little	none	Ditto ditto.
10	10		30.26	+ 0.43	0.474	67	57	70	5.139	5.235	7.013	..	..	..	..	..	55	1.02	....	ditto	haze	Very fine.
	5		30.23	....	0.474	71	57	14	5.105	5.235	8.027	73	..	..	..	..	..	1.08	....	ditto	ditto and cumulo-strati	Ditto ditto.
	11		30.23	— 0.03	0.542	63	61	2	5.928	5.950	6.310	..	57	47	..	..	53	0.14	SW	ditto	haze and cirro-strati	Fine—stars—hazy
11	10		30.26	....	0.524	68	60	8	5.671	5.761	7.316	..	..	..	..	..	56	0.60	....	ditto	haze and light stratus	Very fine.
	4		30.26	+ 0.03	0.578	76	63	13	6.163	6.310	9.385	76	..	..	..	..	..	1.21	NW	ditto	ditto	Ditto ditto.
	11		30.25	....	0.507	64	59	5	5.525	5.570	6.506	..	53	43	..	..	54	0.36	....	ditto	none	Ditto ditto.
12	9		30.23	....	0.474	65	57	8	5.156	5.235	6.614	..	..	..	..	..	54	0.56	....	ditto	ditto	Ditto ditto.
	4		30.20	....	0.578	74	63	11	6.184	6.310	8.807	75	..	..	..	..	..	0.98	....	ditto	ditto	Ditto ditto.
	11		30.18	....	0.415	53	53	..	4.616	....	....	..	55	54	..	..	53	....	....	ditto	cirro-strati	Ditto ditto—foggy smell.
13	10		30.15	....	0.429	63	54	9	4.690	4.770	6.310	..	..	..	..	..	52	0.60	....	ditto	ditto	Ditto ditto.
	5		30.10	....	0.524	74	60	14	5.616	5.761	8.807	75	..	..	..	..	..	1.19	....	ditto	cumulo-strati	Ditto ditto.
	10		30.10	....	0.490	58	58	..	5.402	....	....	..	55	45	..	..	54	....	S	ditto	none	Ditto ditto.
14	10		30.04	....	0.524	70	60	10	5.660	5.761	7.776	..	..	..	..	..	59	0.78	SW	ditto	cumuli and cirri	Ditto ditto.
	4		30.00	....	0.351	77	48	29	3.736	3.940	9.688	77	..	..	..	..	..	2.25	W	ditto	ditto ditto	Beautifully clear.
	10		29.97	....	0.458	56	56	..	5.068	....	....	..	55	44	..	..	52	....	....	calm	none	Ditto ditto.
15	9		29.90	....	0.429	56	54	2	4.783	4.770	5.068	..	..	..	..	..	52	0.12	....	ditto	cirro-cumuli and haze	Ditto ditto.
	5		29.80	....	0.616	75	65	10	6.494	6.614	9.091	77	..	..	..	..	..	1.21	SW	brisk	stratus and cumulo-strati	Fine and close.
	11		29.80	....	0.524	65	60	5	5.710	5.761	6.614	..	64	60	0.02	..	56	0.46	....	ditto	overcast	Dull and close.
16	10		29.79	— 0.47	0.542	71	61	10	5.846	5.950	8.027	..	..	..	..	..	58	1.04	....	ditto	stratus and scud	Overcast and dull—some drops.
	5		29.83	....	0.560	75	62	13	5.979	6.126	9.091	76	..	..	..	..	..	1.49	....	ditto	ditto ditto	Ditto ditto.
	12		29.86	+ 0.07	0.616	68	65	3	6.579	6.614	7.316	..	65	60	..	..	57	0.31	....	ditto	ditto ditto	Ditto—stars at intervals, and showers.
17	10	☾	29.79	....	0.524	71	60	11	5.650	5.761	8.027	..	..	..	..	..	58	1.38	W	high	stratus and cumulo-stratus	Overcast, but fine.
	5		29.78	— 0.08	0.616	72	65	7	6.527	6.614	8.270	78	..	..	..	..	..	0.97	....	ditto	ditto ditto	Very fine.
	11		29.85	....	0.415	60	53	7	4.555	4.616	5.761	..	57	49	..	..	54	0.44	....	little	few	Fine and fresh.
18	10		29.86	....	0.401	62	52	10	4.388	4.468	6.126	..	..	..	..	..	52	0.84	....	calm	light stratus and haze	Fine.
	4		29.86	+ 0.08	0.388	70	51	19	4.183	4.330	7.776	72	..	..	..	..	..	1.33	....	little	cumulo-strati and ditto	Ditto.

	10		29.84	....	0.375	59	50	9	4.124	4.195	5.570	..	50	42	..	..	49	0.53	....	calm	cumulo-strati and ditto	Fine.
Aug. 19	10		29.78	— 0.08	0.401	63	52	11	4.377	4.468	6.310	..	..	..	..	..	52	0.71	....	little	cumuli	Very fine.
	4		29.79	....	0.458	62	56	6	5.010	5.068	6.126	68	..	..	..	..	..	0.41	SW	ditto	ditto and nimbi	Thunder shower.
	11		29.84	....	0.351	51	48	3	3.919	3.940	4.330	..	42	35	..	..	53	0.10	NW	calm	none	Perfectly fine.
20	10		29.92	....	0.375	59	50	9	4.124	4.195	5.570	..	..	..	..	..	..	0.53	...	little	cirro-strati	Ditto ditto.
	3		29.93	....	0.339	64	47	17	3.694	3.815	6.506	65	..	..	..	..	..	1.03	....	calm	cumuli	Very fine.
	11		29.94	+ 0.06	0.351	56	48	8	3.884	3.940	5.068	..	51	42	..	..	..	0.43	....	ditto	cirri	Halo round the moon.
21	10		29.87	....	0.474	58	57	1	5.229	5.235	5.402	..	..	..	..	..	..	0.06	NE	little	stratus	Beginning to rain.
	4		29.84	....	0.490	58	58	..	5.402	....	....	60	50	50	..	..	..	..	....	brisk	ditto very dark	Steady rain.
	10		29.84	....	0.415	53	53	..	4.616	....	....	..	..	..	..	..	..	..	....	high	ditto ditto	Ditto ditto.
22	..		29.82	....	0.388	58	51	7	4.276	4.330	5.402	..	..	..	0.42	..	..	0.64	....	ditto	ditto ditto	Overcast and dull.
	5		29.82	— 0.12	0.388	57	51	6	4.284	4.330	5.235	59	..	..	..	..	..	0.54	NE	high	cumulo-strati	Overcast and dark.
	11		29.90	....	0.351	51	48	3	3.919	3.940	4.330	..	47	42	..	..	..	0.24	....	brisk	cirro-cumuli	Fine.
23	10		30.09	....	0.339	59	47	12	3.723	3.815	5.570	..	..	..	..	..	..	0.86	....	ditto	cumulo-strati	Very fine and exhilarating.
	5		30.12	....	0.328	59	46	13	3.309	3.699	5.570	60	..	..	..	..	..	0.93	....	ditto	ditto ditto	Overcast and dull.
	11		30.14	....	0.388	53	51	2	4.315	4.330	4.616	..	52	48	..	..	..	0.11	....	little	ditto	Fine, but overcast.
24	10	○	30.15	+ 0.33	0.328	63	46	17	3.581	3.699	6.310	..	..	..	..	..	..	1.00	SW	ditto	light stratus and haze	Very fine.
	5		30.12	....	0.351	65	48	17	3.818	3.940	6.614	67	..	..	..	..	..	1.06	....	ditto	cirri and cumuli	Ditto ditto.
	11		30.05	....	0.388	54	51	3	4.307	4.330	4.770	..	51	42	..	..	..	0.16	....	calm	none	Stars and moon bright.
25	10		29.88	....	0.443	61	55	6	4.853	4.910	5.950	..	.	..	..	..	..	0.51	....	brisk	stratus	Overcast and dull.
	4		29.87	....	0.560	65	62	3	6.093	6.126	6.614	67	..	..	..	..	..	0.28	....	ditto	ditto	Ditto ditto
	10		29.80	....	0.542	61	61	..	5.950	....	....	..	53	50	..	..	..	..	....	ditto	ditto	Steady rain.
26	10		29.73	....	0.401	63	52	11	4.377	4.468	6.310	..	..	..	0.03	..	..	0.93	....	ditto	cumuli	Clearing.
	4		29.73	— 0.42	0.524	60	60	..	5.761	....	....	68	..	..	..	..	..	..	....	ditto	ditto and stratus	Showery.
	10		29.75	....	0.429	55	54	1	4.762	4.770	4.910	..	47	42	..	..	..	0.08	....	ditto	cumulo-strati	Fine.
27	10		29.77	....	0.339	58	47	11	3.736	3.815	5.402	..	..	..	..	..	..	0.77	....	ditto	ditto and cumuli	Ditto.
	5		29.77	+ 0.04	0.524	60	60	..	5.761	....	....	66	..	..	0.16	..	..	..	....	ditto	ditto ditto	Showers—hard rain.
	11		29.71	....	0.429	57	54	3	4.744	4.770	5.235	..	51	47	..	..	..	0.23	....	ditto	stratus and ditto	Rain.
28	10		9.85	— 0.22	0.363	59	49	10	3.992	4.068	5.570	..	..	..	0.02	..	..	0.58	W	ditto	cumuli	Fine.
	4		29.60	....	0.363	60	49	11	3.985	4.068	5.761	63	..	..	..	..	..	0.65	NW	ditto	ditto	Ditto.
	11		29.67	....	0.339	49	47	2	3.798	3.815	4.068	..	43	36	..	..	..	0.09	....	little	none	Ditto.
29	10		29.70	....	0.363	59	49	10	3.992	4.068	5.570	..	..	..	..	..	..	0.58	....	ditto	cumuli	Ditto.
	5		29.72	....	0.339	63	47	16	3.700	3.815	6.310	69	..	..	..	..	..	0.95	NW	little	cumuli and cirro-cumuli ..	Very fine.
	11		29.79	....	0.375	54	50	4	4.164	4.195	4.770	..	48	39	..	..	..	0.21	....	ditto	cumulo-strati	Overcast.
30	10	☽	29.91	....	0.351	61	48	13	3.815	3.940	5.950	61	..	..	..	..	..	0.77	....	ditto	ditto and haze	Very fine.
	5		29.94	....	0.388	58	51	7	4.276	4.330	5.402	..	..	..	..	..	.	0.41	....	ditto	ditto and stratus, and ditto	Fine, but overcast.
	11		30.01	....	0.375	51	50	1	4.187	4.195	4.330	..	47	39	..	..	..	0.05	....	ditto	stratus in the horizon	Fine.
31	10		30.06	....	0.429	62	54	8	4.698	4.770	6.126	..	..	..	..	..	..	0.53	W	ditto	cumuli&cumulo-strati&haze	Very fine.
	5		30.07	....	0.388	58	51	7	4.276	4.330	5.402	64	..	..	..	..	..	0.53	N	brisk	cirro-strati	Ditto ditto.
	11		30.09	+ 0.54	0.375	50	49	1	4.060	4.068	4.195	..	47	39	..	..	..	0.05	E	little	none	Moon and stars perfectly bright.

ART. XIV. METEOROLOGICAL DIARY for the Months of June, July, and August, 1820, kept at EARL SPENCER's Seat at Althorp, in Northamptonshire. The Thermometer hangs in a North-eastern Aspect, about five feet from the ground, and a foot from the wall.

For June, 1820.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Thursday - -	1	42	62,5	29,39	29,39	W	WbS
Friday - - - -	2	46	65	29,39	29,48	SW	W
Saturday - -	3	43	59	29,57	29,61	W	W
Sunday - - -	4	46	57	29,74	29,78	W	WbN
Monday - - -	5	37	67	29,84	29,80	W	W
Tuesday - -	6	48	58,5	29,76	29,93	WNW	NE
Wednesday -	7	44	64	29,93	29,80	W	WNW
Thursday - -	8	43	63	29,84	29,80	WbW	NW
Friday - - -	9	52	60,5	29,70	29,62	NW	NW
Saturday - -	10	41,5	60	29,62	29,62	WNW	WNW
Sunday - - -	11	38,5	57,5	29,46	29,40	SW	SW
Monday - - -	12	45	64	29,59	29,75	NE	NE
Tuesday - - -	13	38	67	29,75	29,75	W	NW
Wednesday -	14	48	62	29,92	29,92	NNE	W
Thursday - -	15	49	62,5	29,70	29,77	NW	N
Friday - - - -	16	44	61	29,89	29,80	W	W
Saturday - -	17	49	71	29,83	29,86	W	W
Sunday - - -	18	45	67	29,99	29,78	WbN	SW
Monday - - -	19	52	69	29,60	29,60	SW	W
Tuesday - - -	20	49	62	29,48	29,67	W	WbN
Wednesday -	21	44	69	29,73	29,80	WbN	W
Thursday - -	22	43	70	29,98	30,00	WbS	W
Friday - - - -	23	49	72	30,00	30,00	W	W
Saturday - -	24	48	82	30,00	30,00	W	WSW
Sunday - - -	25	52	85	30,20	30,20	w	W
Monday - - -	26	55	83,5	30,27	30,27	W	NW
Tuesday - - -	27	56	86	30,27	30,25	E	NNE
Wednesday -	28	58	84,5	30,22	30,12	W	WbN
Thursday - -	29	57	76	30,07	29,97	EbS	ENE
Friday - - -	30	57	66,5	29,89	29,90	NE	NE

For July, 1820.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Saturday - -	1	47	67	30,10	30,12	NNE	NE
Sunday - - -	2	44,5	66,5	30,05	29,90	WbS	WbN
Monday - - -	3	47	66	29,87	29,80	WbN	WbN
Tuesday - - -	4	50	62,5	29,84	29,90	NNW	NNW
Wednesday -	5	49	67	30,00	30,00	NNE	NE
Thursday - -	6	45	65	30,02	30,06	NW	E
Friday - - - -	7	44	67,5	30,06	30,03	NE	NE
Saturday - -	8	54	63	30,00	30,00	NE	NE
Sunday - - -	9	51	65	30,07	30,06	NE	E
Monday - - -	10	54	65	30,03	29,97	E	EbS
Tuesday - - -	11	43	70	29,97	29,90	ESE	ESE
Wednesday -	12	45	69	29,88	29,79	SE	NE
Thursday - -	13	50	60,5	29,77	29,77	E	ENE
Friday - - - -	14	51	66	29,79	29,79	E	EbN
Saturday - -	15	55	75	29,89	29,87	E	E
Sunday - - -	16	50	72	29,87	29,79	SE	E
Monday - - -	17	59	67,5	29,54	29,37	E	WSW
Tuesday - - -	18	52	66	29,28	29,21	S	W
Wednesday -	19	50	70	29,40	29,50	NW	W
Thursday - -	20	49	75,5	29,89	29,95	W	E
Friday - - - -	21	55	73	29,77	29,81	NW	NW
Saturday - -	22	46	71	29,81	29,78	NW	W
Sunday - - -	23	54	69	29,85	29,85	NW	W
Monday - - -	24	51	70,5	29,85	29,83	W	W
Tuesday - - -	25	58	72	29,76	29,76	W	W
Wednesday -	26	49	70,5	29,87	29,90	W	W
Thursday - -	27	56	76	29,90	29,88	W	WbS
Friday - - - -	28	56,5	74	29,88	29,90	W	NW
Saturday - -	29	47	76	29,94	29,94	NW	W
Sunday - - -	30	49	79	29,94	29,84	E	SE
Monday - - -	31	53	82	29,76	29,70	SW	SW

For August, 1820.

		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Tuesday - - -	1	62	77,5	29,60	29,71	WbS	W
Wednesday -	2	51	77	29,81	29,93	SW	W
Thursday - -	3	61	71	29,87	29,73	SW	SW
Friday - - - -	4	63,5	76	29,60	29,62	SbW	W
Saturday - -	5	53,5	74,5	29,70	29,70	WSW	W
Sunday - - -	6	57	68	29,54	29,44	WbS	SW
Monday - - -	7	55	68,5	29,52	29,79	W	W
Tuesday - - -	8	46	70	29,84	29,99	W	W
Wednesday -	9	54	74	29,76	29,91	W	W
Thursday - -	10	48	76	30,11	30,17	WbS	W
Friday - - - -	11	49	77,5	30,17	30,10	W	W
Saturday - -	12	47	76	30,10	30,05	NW	W
Sunday - - -	13	45	74	30,05	29,90	W	W
Monday - - -	14	48	76	29,88	29,80	W	SW
Tuesday - - -	15	58,5	76,5	29,78	29,68	SW	SW
Wednesday -	16	61,5	75,5	29,63	29,66	SW	SW
Thursday - -	17	65	74	29,60	29,65	SW	NW
Friday - - - -	18	53	71	29,71	29,68	NW	NW
Saturday - -	19	41	70,5	29,64	29,61	NW	NW
Sunday - - -	20	42,5	69	29,74	29,74	NW	NW
Monday - - -	21	48	63,5	29,77	29,73	NE	NE
Tuesday - - -	22	48,5	61	29,73	29,79	NE	NE
Wednesday -	23	46	62	29,90	30,00	NNW	NW
Thursday - -	24	36	69	30,01	29,91	NW	WbS
Friday - - - -	25	52,5	66	29,74	29,60	SW	SW
Saturday - -	26	52	69	29,53	29,53	W	W
Sunday - - -	27	48	67	29,59	29,57	WbS	W
Monday - - -	28	51	64	29,36	29,40	W	W
Tuesday - - -	29	45,5	69	29,47	29,59	W	W
Wednesday -	30	49	68	29,70	29,80	W	LSE
Thursday - -	31	44,5	65,5	29,93	29,98	E	SE

Art. XIV. *Astronomical and Nautical Collections.*—No. III.

i. Tables *subservient to the Calculation of* Lunar Occultations.

1. A Table *of the* Places *of all* Stars, *not below the fourth Magnitude, that are liable to* Lunar Occultations.

Extracted from Mr. Pond's Observations, Vol. II.

1820. Jan 1.		AR	Ann. Var.	N. P. D.	Ann. Var.	N. E. Angle of ☽'s Orbit with Meridian.	
		H. M. S.	s.	° ′ ″	″	☽ asc.	☽ desc.
1	ε 71 ♓	0 53 36,49	+3,11	83 4 49,0	—19,5	62°	72°
2	ζ 86 ♓	1 4 19,90	3,11	83 22 41,1	19,3	62	72
3	η 99 ♓	1 21 51,80	3,19	75 35 2,7	18,8	67	69
4	ν 106 ♓	1 32 4,13	3,10	85 25 33,4	18,5	66	70
5	ο 110 ♓	1 35 54,82	3,15	81 45 3,9	18,4	64	74
6	2ξ 73 Ceti	2 18 35,78	3,16	82 21 3,8	16,7		
7	μ 87 Ceti	2 35 13,10	3,20	80 39 3,7	15,6		
8	δ 57 ♈	3 1 20,89	3,39	70 57 37,3	14,2	69	79
9	f 5 ♉	3 20 56,73	3,28	77 41 11,3	12,9		
10	η 25 ♉	3 36 47,43	3,53	66 27 32,7	11,8	73	79
11	A 37 ♉	3 54 4,14	3,52	68 25 3,8	10,5	73	83
12	γ 54 ♉	4 9 33,51	3,40	74 48 53,0	9,4		
13	1δ 61 ♉	4 12 33,87	3,43	72 53 14,7	9,1	76	82
14	2δ 64 ♉	4 13 43,73	3,43	72 58 51,0	9,1	77	83
15	2κ 67 ♉	4 14 42,45	3,54	68 13 10,8	9,0	75	85
16	ε 74 ♉	4 18 7,01	3,49	71 13 38,4	8,6	76	86
17	α 87 ♉	4 25 36,02	3,43	73 51 39,2	8,0	80	81
18	ι 102 ♉	4 52 20,54	3,57	68 40 33,9	5,9	78	88
19	β 112 ♉	5 14 55,07	3,78	61 33 16,5	3,9	84	86
20	ζ 123 ♉	5 26 53,36	3,57	68 58 35,9	3,0	81	91
21	132 ♉	5 37 58,24	3,67	65 30 15,1	— 2,0	83	93
22	κ 44 Aur.	6 3 54,24	3,82	60 26 43,6	+ 0,2		
23	η 7 ♊	6 4 0,64	3,63	67 27 2,2	0,2	85	95
24	μ 13 ♊	6 12 3,09	3,63	67 24 13,8	1,2	86	96
25	ν 18 ♊	6 18 16,35	3,55	69 40 59,7	1,5	87	95
26	ε 27 ♊	6 32 51,07	3,69	64 42 1,3	2,8	88	98
27	ζ 43 ♊	6 53 25,56	3,56	69 10 28,5	4,5	90	100

1820. Jan. 1.				AR.			Ann. Var.	N. P. D.			Ann. Var.	N.E. Angle of ☽'s Orbit with Meridian.	
				H.	M.	S.	s.	°	′	″	″	☽ asc.	☽ desc.
28	δ	55	♊	7	9	21,65	3,59	67	41	42,5	5,9	91	101
29	ι	60	♊	7	14	32,08	3,74	61	51	12,5	6,3		
30	υ	69	♊	7	24	49,05	+3,71	62	42	46,5	+7,1	96°	98°
31	κ	77	♊	7	33	34,03	3,63	65	10	44,1	7,9	95	103
32	γ	43	♋	8	32	51,08	3,49	67	53	27,3	12,4	100	108
33	δ	47	♋	8	34	26,42	3,43	71	11	26,2	12,7	100	110
34	1α	60	♋	8	46	4,97	3,29	77	41	30,7	13,2	104	106
35	2α	65	♋	8	48	37,81	3,29	77	27	4,3	13,5	104	106
36	ξ	5	♌	9	22	13,98	3,25	77	54	27,3	15,4	104	112
37	ο	14	♌	9	31	31,91	3,21	79	17	35,2	15,9	105	111
38	π	29	♌	9	50	41,36	3,18	81	5	44,6	16,9	106	112
39	η	30	♌	9	57	30,29	3,28	72	21	48,0	17,2	108	112
40	α	32	♌	9	58	46,43	3,21	77	9	23,0	17,3	105	115
41	ρ	47	♌	10	23	19,32	3,16	79	46	10,0	18,2	106	116
42	σ	77	♌	11	11	51,08	3,10	82	59	5,6	19,6	108	118
43	(ι	78	♌)	11	14	31,00	3,11	78	28	42,0	19,6		
44	τ	84	♌	11	18	40,61	3,09	86	9	10,3	19,7	108	118
45	υ	91	♌	11	27	43,87	3,07	89	49	48,1	19,9	109	117
46	(β	5	♍)	11	41	18,84	3,12	87	13	14,7	20,0	108	118
47	η	15	♍	12	10	41,82	3,07	89	39	52,7	20,0	108	118
48	γ	29	♍	12	32	32,52	3,02	90	27	35,9	19,9	111	117
49	ϑ	51	♍	13	0	38,17	3,09	94	34	26,5	19,0	108	118
50	α	67	♍	13	15	43,25	3,15	100	13	2,4	19,0	107	117
51	i	68	♍	13	17	13,20	3,15	101	46	2,6	19,0	108	116
52	κ	98	♍	14	3	18,18	3,17	99	24	57,0	17,2	106	114
53	λ	100	♍	14	9	22,88	3,22	102	32	10,4	17,0	105	115
54	2α	9	♎	14	40	56,08	3,30	105	17	9,2	15,2	103	113
55	4ζ	35	♎	15	22	45,78	3,36	106	13	5,91	12,8	100	110
56	γ	38	♎	15	25	28,31	3,32	104	10	48,0	12,1	102	108
57	κ	43	♎	15	31	35,29	3,43	109	5	8,1	12,2	99	109
58	λ	45	♎	15	42	53,87	3,45	109	37	8,3	11,4	98	108
59	ϑ	46	♎	15	43	35,17	3,38	106	11	29,6	11,3	107	109
60	π	6	♏	15	47	58,66	3,59	115	35	8,0	11,0	94	104
61	ψ	48	♎	15	48	7,19	3,33	103	45	0,4	11,0		

	1820. Jan. 1.		AR. H. M. S.	Ann. Var. s.	N. P. D. ° ′ ″	Ann. Var. ″	N.E. Angle of ☽'s Orbit with Meridian, ☽ asc.	☽ desc
62	δ	7 ♏	15 49 42,26	+3,51	112 5 55,6	+10,9	97°	107°
63	1β	8 ♏	15 54 56,11	3,47	109 18 8,7	10,5	97	107
64	2β	8 ♏	15 54 59,58	+3,47	109 17 55,5	+10,5	97	107
65	ν	14 ♏	16 1 32,69	3,46	108 58 57,3	10,0	96	106
66	σ	20 ♏	16 10 15,74	3,61	115 8 58,0	9,3	98	104
67	α	21 ♏	16 18 23,01	3,66	116 1 14,7	8,6	97	103
68	φ	8 Oph.	16 20 50,67	3,41	106 12 35,5	8,5	99	101
69	τ	23 ♏	16 24 41,41	3,71	117 49 50,1	8,2		
70	A	36 Oph.	17 4 17,43	3,70	116 19 24,5	4,9		
71	ϱ	40 Oph.	17 10 13,21	3,56	110 54 27,4	4,4	91	101
72	ϑ	42 Oph.	17 10 57,73	3,67	114 48 27,8	4,4	90	100
73	B	44 Oph.	17 15 22,77	3,64	113 59 50,0	+4,0	90	100
74	1μ	13 ♐	18 2 59,86	3,59	111 5 37,4	—0,2	85	95
75	2μ	15 ♐	18 4 28,73	3,59	110 46 11,0	0,3	85	95
76	δ	19 ♐	18 9 28,02	3,84	119 53 30,0	0,7		
77	λ	22 ♐	18 16 51,53	3,70	115 30 31,6	1,2	84	94
78	1ν	32 ♐	18 43 17,80	3,62	112 57 15,7	3,6	81	91
79	σ	34 ♐	18 44 5,88	3,73	116 30 21,5	3,6	82	90
80	ο	39 ♐	18 53 53,29	3,59	111 59 35,7	4,6	81	91
81	τ	40 ♐	18 55 41,89	3,75	117 55 15,8	4,7	84	86
82	π	41 ♐	18 59 3,14	3,57	111 17 53,8	4,9	80	90
83	ψ	42 ♐	19 4 29,57	3,68	115 33 17,7	5,5	80	88
84	d	43 ♐	19 7 5,76	3,51	109 15 42,4	5,7		
85	b	59 ♐	19 45 53,11	3,69	117 38 10,0	8,8		
86	β	9 ♑	20 10 53,23	3,38	105 20 23,9	10,8	76	80
87	ϑ	23 ♑	20 55 48,76	3,37	107 56 23,0	13,8	69	79
88	ε	39 ♑	21 26 59,04	3,37	110 15 54,8	15,7	70	74
89	γ	40 ♑	21 30 6,08	3,34	107 28 6,9	15,8	68	76
90	δ	49 ♑	21 37 5,43	3,33	106 56 13,1	16,2	67	75
91	ϑ	43 ♒	22 7 19,36	3,17	98 40 27,8	17,5	66	74
92	2τ	71 ♒	22 40 3,13	3,19	104 32 48,3	18,8		
93	λ	73 ♒	22 43 13,09	3,13	98 32 0,5	18,9	63	73
94	φ	90 ♒	23 4 59,51	3,10	97 0 58,2	19,4	62	72
95	ω	28 ♓	23 50 4,03	3,05	84 7 55,1	20,0		

2. A TABLE, *showing the Logarithms of the Corrections in Seconds, to be applied with the proper Signs of the Sines.*

STARS.	ABERRATION. AR. in Time. L. Sin. (☉'s Long. +	ABERRATION. N. P. D. in Space. L. Sin. (☉'s Long. +	SOLAR NUTATION. AR. in Time. L. Sin. (2 ☉'s Long. +	SOLAR NUTATION. N. P. D. in Space. L. Sin. (2 ☉'s Long. +	LUNAR NUTATION. AR. in Time. L. Sin. (☊'s Long. +	LUNAR NUTATION. N. P. D. in Space. L. Sin. (☊'s Long. +
	S. D. M.	S. D. M.	S. M. D.	S. D. M.	S. D. M.	S. D. M.
1 ε ♓	8 15 49)+.0973	2 12 48)+.8963	6 3 9)+8.792	11 15 27)+9.602	6 3 50)+.0486	11 12 45)+.8648
2 ζ ♓	8 12 52 .0989	2 13 35 .8899	6 2 59 8.793	11 12 33 or	6 3 37 .0493	11 9 8 .8690
3 η ♓	8 8 7 .1115	1 22 59 .8925	6 6 15 8.806	11 7 52 9.62	6 7 40 .0627	11 3 43 .8759
4 ν ♓	8 5 24 .1002	2 20 46 .8822	6 1 58 8.794	11 5 9 for all.	6 2 23 .0490	11 0 37 .8803
5 ο ♓	8 4 25 .1038	2 9 17 .8705	6 3 30 8.798	11 4 8	6 4 16 .0545	10 29 28 .8820
6 2ξ Ceti	7 23 20 .1086	2 11 39 .8457	6 2 54 8.801	10 23 0	6 3 34 .0554	10 17 42 .9058
7 μ Ceti	7 19 6 .1128	2 7 18 .8182	6 3 20 8.806	10 18 46	6 4 6 .0509	10 13 4 .9175
8 δ ♈	7 12 33 .1365	1 5 54 .7586	6 5 55 8.833	10 12 12	6 7 19 .0896	10 6 39 .9303
9 f ♉	7 7 40 .1254	2 0 16 .7489	6 3 31 8.818	10 7 22	6 4 13 .0740	10 1 57 .9404
10 η ♉	7 3 49 .1556	0 16 35 .6955	6 5 58 8.851	10 3 30	6 7 22 .1078	9 28 23 .9483
11 A ♉	7 0 23 .1521	0 23 34 .6326	6 4 52 8.847	9 29 20	6 6 2 .1031	9 24 43 .9559
12 γ ♉	6 25 53 .1379	1 24 48 .6335	6 3 5 8.830	9 25 38	6 3 50 .0865	9 21 38 .9615
13 1δ ♉	6 25 10 .1426	1 26 38 .5983	6 3 22 8.836	9 24 56	6 4 11 .0927	9 20 39 .9633
14 2δ ♉	6 24 57 .1425	1 17 7 .5948	6 3 19 8.836	9 24 39	6 4 8 .0922	9 20 38 .9633
15 2κ ♉	6 24 39 .1549	0 21 54 .5595	6 4 9 8.850	9 24 24	6 5 1 .1067	9 20 23 .9642
16 ε ♉	6 21 58 .1466	1 8 53 .5606	6 3 29 8.841	9 23 36	6 4 21 .0980	9 19 49 .9652
17 α ♉	6 22 9 .1422	1 23 26 .5806	6 2 49 8.834	9 21 51	6 3 31 .0904	9 18 18 .9673
18 ι ♉	6 15 51 .1582	0 26 40 .3800	6 2 39 8.852	9 15 36	6 3 19 .1074	9 12 58 .9758
19 β ♉	6 10 39 .1844	10 21 8 .3963	6 2 20 8.914	9 10 21	6 2 58 .1328	9 8 40 .9810
20 ζ ♉	6 7 53 .1594	1 11 15 .1608	6 1 0 8.869	9 7 36	6 1 39 .1089	9 6 23 .9820

21	132/8	6	5	16	.1709	11	9	21	.9499	6	0	59	8.936	9	5	4	6	1	27	.1208	9	4	15	.9852
22	κ Aur.	5	29	29	.1914	8	27	22	.3284	5	29	47	8.919	8	29	6	5	29	43	.1376	8	29	28	.9841
23	η ♊	5	29	25	.1650	3	15	43	9.5507	5	29	28	8.896	8	29	5	5	29	9	.1147	8	29	31	.9847
24	μ ♊	5	27	34	.1647	4	18	54	9.6867	5	29	30	8.896	8	27	14	5	29	8	.1153	8	28	4	.9841
25	ν ♊	5	26	4	.1579	3	24	33	.0967	5	29	19	8.851	8	25	49	5	29	13	.1073	8	26	46	.9840
26	ε ♊	5	22	40	.1735	6	25	27	.1217	5	28	29	8.867	8	22	27	5	28	12	.1233	8	24	7	.9831
27	ζ ♊	5	17	56	.1582	4	25	35	.2990	5	27	57	8.851	8	17	43	5	27	31	.1078	8	20	15	.9801
28	δ ♊	5	14	21	.1614	5	12	26	.5163	5	27	10	8.854	8	14	1	5	26	24	.1118	8	16	56	.9752
29	ι ♊	5	13	9	.2005	6	29	13	.5148	5	26	12	8.874	8	12	49	5	25	13	.1307	8	16	12	.9751
30	υ ♊	5	10	42	.1772	6	13	23	.5325	5	25	50	8.872	8	10	25	5	24	56	.1269	8	14	7	.9720
31	κ ♊	5	8	34	.1724	5	28	46	.5240	5	25	48	8.821	8	8	21	5	24	53	.1180	8	12	26	.9693
32	γ ♋	4	24	27	.1503	5	7	30	.7065	5	24	58	8.846	7	24	9	5	22	42	.1030	7	29	56	.9452
33	δ ♋	4	24	6	.1407	4	24	11	.7818	5	24	51	8.837	7	23	47	5	23	41	.0938	8	0	22	.9442
34	1α ♋	4	21	10	.1250	4	0	19	.7536	5	26	21	8.816	7	20	55	5	25	49	.0739	7	27	5	.9377
35	2α ♋	4	20	33	.1249	4	1	15	.7552	5	26	14	8.817	7	20	18	5	25	30	.0742	7	26	20	.9370
36	ξ ♌	4	12	11	.1190	4	1	24	.8069	5	25	46	8.813	7	11	53	5	24	47	.0696	7	18	8	.9182
37	ο ♌	4	9	29	.1149	3	27	26	.8161	5	26	7	8.809	7	9	31	5	25	12	.0648	7	15	49	.9148
38	π ♌	4	4	53	.1088	3	22	26	.8315	5	26	33	8.803	7	4	37	5	25	43	.0597	7	10	48	.9017
39	η ♌	4	3	7	.1236	4	17	44	.8575	5	23	6	8.818	7	2	50	5	21	13	.0771	7	8	49	.8979
40	α ♌	4	2	49	.1141	4	4	24	.8414	5	24	56	8.803	7	2	30	5	23	45	.0661	7	8	32	.8972
41	ρ ♌	3	26	18	.1069	3	26	38	.8671	5	25	44	8.802	6	26	4	5	24	39	.0584	7	1	28	.8850
42	σ ♌	3	13	30	.0981	3	18	1	.8983	5	26	46	8.792	6	13	5	5	25	59	.0487	6	16	26	.8645
43	ι ♌	3	12	35	.1034	3	29	9	.9139	5	24	42	8.796	6	12	22	5	23	26	.0531	6	15	17	.8628
44	τ ♌	3	11	30	.0950	3	9	56	.9025	5	28	13	8.789	6	11	14	5	27	44	.0451	6	14	10	.8624
45	υ ♌	3	9	0	.0935	3	0	44	.9058	5	29	56	8.785	6	8	47	5	29	50	.0426	6	11	13	.8602
46	β ♍	3	5	25	.0934	3	7	13	.9052	5	28	41	8.786	6	5	5	5	28	20	.0431	6	6	29	.8563
47	η ♍	2	27	21	.0932	3	1	5	.9064	5	29	50	8.786	5	27	6	5	29	45	.0426	5	26	50	.8577
48	γ ♍	2	21	24	.0935	2	29	8	.9058	6	0	14	8.786	5	21	0	6	0	13	.0429	5	15	12	.8610

A TABLE *of Corrections*, continued.

STARS.	ABERRATION. AR. in Time. L. Sin. (☉'s Long. +	ABERRATION. N. P. D. in Space. L. Sin. (☉'s Long. +	SOLAR NUTATION. AR. in Time. L. Sin. (2 ☉'s Long. +	SOLAR NUTATION. N. P. D. in Space. L. Sin. (2 ☉'s Long. +	LUNAR NUTATION. AR. in Time. L. Sin. (☊'s Long. +	LUNAR NUTATION. N. P. D. in Space. L. Sin. in ☊'s Long. +
	S. M. D.	S. D. M.	S. D. M.	S. D. M.	S. D. M.	S. D. M.
49 ϑ ♍	2 13 47)+.0972	2 18 52)+.8931	6 2 6)+8.783	5 13 32)+9.62	6 2 30)+.0467	5 10 20)+.8675
50 α ♍	2 9 44 .1041	2 4 2 .8847	6 4 44 8.777	5 9 30	6 5 30 .0548	5 5 39 .8760
51 i ♍	2 9 25 .1062	1 29 55 .8885	6 5 29 8.775	5 9 6	6 6 18 .0584	5 5 9 .8744
52 κ ♍	1 27 19 .1094	2 6 19 .8495	6 4 0 8.771	4 26 57	6 4 34 .0610	4 21 43 .8963
53 λ ♍	1 25 39 .1143	1 27 22 .8452	6 5 21 8.765	4 25 23	6 5 55 .0661	4 18 32 .9007
54 2α ♎	1 17 31 .1246	1 19 4 .7908	6 6 6 8.754	4 17 19	6 6 27 .0771	4 11 33 .9186
55 4ζ ♎	1 6 41 .1337	1 16 24 .7172	6 5 32 8.744	4 6 55	6 5 35 .0854	4 1 8 .9418
56 γ ♎	1 6 30 .1294	1 24 11 .7251	6 4 40 8.749	4 6 16	6 4 52 .0796	4 1 0 9.422
57 κ ♎	1 5 3 .1418	1 4 46 .6899	6 6 25 8.734	4 4 45	6 6 13 .0939	3 29 29 .9447
58 λ ♎	1 2 20 .1452	1 2 57 .6621	6 6 13 8.730	4 2 1	6 5 58 .0968	3 27 5 .9507
59 ϑ ♎	1 2 9 .1369	1 17 41 .6760	6 4 55 8.740	4 1 51	6 4 56 .0870	3 26 53 .9513
60 π ♏	1 1 4 .1744	0 7 7 .6826	6 8 30 8.708	4 0 47	6 7 27 .1157	3 25 57 .9527
61 ψ ♎	1 0 58 .1323	1 27 59 .6923	6 3 57 8.747	4 0 45	6 4 5 .0806	3 25 50 .9527
62 δ ♏	1 0 41 .1530	0 21 41 .6471	6 6 56 8.720	4 0 22	6 6 23 .1050	3 25 37 .9539
63 1β ♏ } 64 2β ♏ }	0 29 22 .1457	1 4 36 .6269	6 5 39 8.728	3 29 6	6 5 22 .0972	3 24 33 .9559
65 γ ♏	0 27 52 .1460	1 6 34 .6115	6 5 17 8.727	3 27 33	6 5 3 .0969	3 23 11 9.591
66 σ ♏	0 25 43 .1662	0 4 52 .6026	6 7 7 8.703	3 25 28	6 6 8 .1170	3 21 20 .9619
67 α ♏	0 23 49 .1701	11 28 56 .5853	6 6 59 8.697	3 23 32	6 5 49 .1209	3 19 37 .9652
68 σ Oph.	0 23 15 .1416	1 22 0 .5894	6 3 44 8.734	3 22 58	6 4 38 0.9914	3 19 13 [illegible]

69	τ	♏	0	23	35	.1784	11	19	9	.5943	6	7	17	8.688	3	22	4	6	5	56	.1271	3	18	25	.9672
70	A Oph.		0	13	4	.1769	11	11	11	.3664	6	4	4	8.685	3	12	49	6	3	19	.1243	3	9	27	.9791
71	ρ	♏	0	11	38	.1584	10	26	40	.2856	6	2	40	8.710	3	11	27	6	2	31	.1079	3	9	28	.9791
72	ϑ	♏	0	11	33	.1708	11	21	24	.2727	6	3	18	8.692	3	11	16	6	2	49	.1207	3	9	25	.9798
73	B Oph.		0	10	31	.1683	0	0	0	.2095	6	2	53	8.696	3	10	15	6	2	31	.1201	3	9	27	.9791
74	1μ	♐	11	29	33	.1603	3	3	20	9.9304	6	29	50	8.707	2	29	19	5	29	55	.1099	2	29	35	.9847
75	2μ	♐	11	29	18	.1597	3	6	15	9.9840	5	29	46	8·708	2	28	52	5	29	51	.1087	2	29	17	.9848
76	δ	♐	11	28	9	.1922	2	21	2	.3596	5	29	9	8.663	2	27	50	5	29	26	.1391	2	28	32	.9844
77	λ	♐	11	26	25	.1749	7	19	20	9.9597	5	28	48	8.686	2	26	8	5	29	6	.1242	2	26	59	.9835
78	1ν	♐	11	20	21	.1650	5	17	42	.1677	5	27	22	8.699	2	20	3	5	27	49	.1152	2	22	7	.9818
79	σ	♐	11	20	11	.1764	6	28	47	.2820	5	26	50	8.684	2	19	52	5	27	27	.1263	2	21	56	.9813
80	ο	♐	11	17	52	.1614	5	7	35	.2730	5	26	56	8.706	2	17	37	5	27	23	.1117	2	20	7	.9797
81	τ	♐	11	17	30	.1823	7	0	40	.4120	5	25	34	8.678	2	17	12	5	26	34	.1311	2	19	45	.9792
82	π	♐	11	16	41	.1588	5	1	57	.3216	5	26	47	8.709	2	16	24	5	27	13	.1090	2	19	5	.9788
83	ψ	♐	11	15	30	.1731	6	10	29	.3820	5	25	31	8.691	2	15	9	5	26	23	.1226	2	18	2	.9781
84	d	♐	11	14	49	.1526	4	17	30	.4106	5	26	48	8.719	2	14	33	5	27	10	.1021	2	17	32	.9768
85	b	♐	11	5	44	.1755	6	8	10	.6216	5	22	7	8.692	2	5	27	5	23	37	.1262	2	9	56	.9647
86	β	♑	10	29	50	.1351	4	8	45	.6645	5	25	33	8.742	1	29	29	5	25	32	.0851	2	4	41	.9545
87	ϑ	♑	10	18	45	.1352	4	20	50	.7466	5	23	16	8.743	1	18	30	5	23	14	.0877	1	24	35	.9334
88	ε	♑	10	14	38	.1315	4	19	19	.7777	5	21	21	8.776	1	10	40	5	22	50	.0846	1	20	38	.9248
89	γ	♑	10	10	12	.1282	4	18	33	.8090	5	22	40	8.753	1	9	53	5	22	20	.0816	1	16	10	.9131
90	δ	♑	10	8	22	.1257	4	16	38	.8191	5	22	47	8.755	1	8	6	5	22	22	.0789	1	14	19	.9095
91	ϑ	♒	10	0	29	.1071	3	22	16	.8552	5	26	15	8.753	1	0	16	5	25	37	.0573	1	6	3	.8938
92	2τ	♒	9	21	57	.1119	4	7	50	.8942	5	23	10	8.773	0	21	37	5	22	11	.0634	0	26	29	.8770
93	λ	♒	9	21	4	.1021	3	22	8	.8813	5	26	5	8.778	0	20	47	5	25	21	.0535	0	25	30	.8740
94	φ	♒	9	15	11	.0987	3	18	5	.8944	5	26	43	8.782	0	14	56	5	26	2	.0484	0	18	34	.8663
95	ω	♓	9	2	54	.0949	2	16	3	.9219	6	2	47	8.786	0	2	42	6	3	22	.0423	0	5	12	.8576

3. Occultations *for the different Places of the* Moon's Node.

Selected from Bode, Berl. Jahrb. 1780.

☊ in ♓, XI^s.

7° ε♓, ηf, β☊ κAu. ιυ♊, γ♋, στ♌ βαι♍, π, σα♏, τ♐, γδ♑, λφ♒

24 ε♓, ηf, β☊, κ Au. ιυ♊, γ♋, ρστ♌ β, αι♍, π, σατ♏, τ♐, γδ♑, λφ♒

21 ε♓, ηf, β☊, κ Au. ιυ♊, γ♋, ρστ♌ β, αι♍, π, σατ♏, τ♐, γδ♑, λφ♒

18 ε♓, ηf, β☊, κ Au. υκ♊, γ♋, ρτ♌ β, αι♍, π, σατ♏, τ♐, γδ♑, λφ♒

15 , ηf, β☊, υκ♊, γ♋α, ρτ♌, αι♍, π, σατ♏, στ♐, γδ♑, λφ♒

12 , ηf, β☊, υκ♊, γ♋α, ρτ♌, αι♍, π, σατ♏, στ♐, γδ♑, λφ♒

9 , ηf, β☊, κ♊, γ♋α, ρτ♌, ι♍, π, σατ♏, στψ♐, γδ♑, λ♒

6 , ηf, β☊, κ♊, γ♋α, ρτ♌, ι♍, π, σατ♏, στψ♐, γδ♑, λ♒

3 , ηf, β☊, κ♊, γ♋α, ρτ♌, ι♍, π, σατ♏, στψ♐, , λ♒

0 , ηf, β☊, κ♊, γ♋α, ρτυ♌, ι♍, π, σατ♏, σψ♐, ϑ♑, λ♒

☊ in ♒, X^s.

27° , ηf, β☊, κ♊, α, ρυ♌, ι♍, π, σατ♏, σψ♐, ϑ♑, ,

24 , ηf, β☊, κ♊, α, ρυ♌, ι♍, π, σατ♏ A Oph., σψ♐, ϑ♑, ,

21 , ηf, β☊, κ♊, δ♋α, ρυ♌, ι♍, π, σα♏ A Oph., σψ♐, ϑ♑, ,

18 , ηf, β☊, εκ♊, δ♋α, υ♌, ι♍, π, σα♏ A Oph., σψ♐, ϑ♑, ,

15 , ηf, β☊, εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λσψ♐, ϑ♑, ,

12 , ηf☊, , εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λσψ♐, ϑ♑, ϑ♒

9 , ηf☊, , εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λσψ♐, ϑ♑, ϑ♒

6 , ηf☊, , εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λσψ♐, ϑ♑, ϑ♒

3 , ηf☊, , εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λψ♐, ϑ♑, ϑ♒

0 , ηf☊, , εκ♊, δ♋, υ♌, , π, σα♏ A Oph., λ♐, , ϑ♒

☊ in ♑, IX^s.

27° , ηf☊, , εδκ♊, δ♋, υ♌, , π, σα♏ A Oph., λ♐, , ϑ♒

24 , ηf☊, , εδκ♊, δ♋ξπ, υ♌, , , σα♏, A ϑ Oph., λ♐, , ϑ♒

21 , ηf, 132☊, εδκ♊, ξοπ♌, , , , σα♏ A ϑ Oph., λιν♐, , ϑ♒

18 , ηf, 132 ♉ , εδκ ♊ , ξοπ ♌ , , , σαm A ϑ Oph. , λιν ♐ , , ϑ ♒
15 , ηf, 132 ♉ , δκ ♊ , ξοπ ♌, , , , σm A ϑ B Oph. λινο ♐ , , ϑ ♒
12 , ηf, 132 ♉ , δκ ♊ , ξοπ ♌, , , , σm ϑ B Oph. , ινο ♐ , ϑ ♒
9 , ηf, 132 ♉ , δκ ♊ , ξοπ ♌, , , δ, σm ϑ B Oph. , ινοπ ♐ , , ϑ ♒
6 , ηf, 132 ♉ , μδκ ♊ , ξοπ ♌ , , , δm, ϑ B Oph. , ινοπ ♐ , , ,
3 , ηf, 132 ♉ , ημδκ ♊ , ξοπ ♌, , , δm, ϑ B Oph. , ινοπ ♐ , , ω ♓
0 , f, A 132 ♉ , ημδκ ♊ , ξοπ ♌ , , , δm, ϑ B Oph. , ινοπ ♐ , , ω ♓

♋ in ♐, VIII[s].

27° , , A 132 ♉ , ημζ ♊ , ξοπ ♌, , , δm, ϑ B Oph. , ινοπ ♐ , , ω ♓,
24 , δ♌, A 2κ132 ♉ , ημζ ♊ , ξοπ ♌ , im♍ , δm , B Oph. , ινοπ ♐ , ,
21 , δ♌, A2κ ♉ , ημζ ♊ , ξοπ ♌ , im♍ , δm, B Oph. , οπa ♐ , ,
18 , δ♌, A2κ ♉ . ημζ ♊ , ξοπ ♌, im♍, δm, B Oph. οπd ♐ , β♍ , ,
15 , δ♌, A2κ ♉ , ημζ ♊ , οπ ♌, im♍, δm, B Oph. , 1.2μπd ♐ , β♍ , ,
12 , δ♌, A2κι ♉ , ημνζ ♊ , οπ ♌, im♍, δm, , 1.2μπd ♐ , β♍ , ,
9 , δ♌, A2κιζ ♉ , ημνζ ♊ , 1α♎οπ ♌ , i m♍, δ m, ϱ Oph., 1.2μπd ♐ , β ♍, ,
6 , δ♌, A2κιζ ♉ , ηνζ ♊ , 1. 2α♎οπ ♌ , im♍, κλ♏, ϱ Oph. 1.2μd ♐ , β♍, ,
3 , δ♌, A2κιζ ♉ , νζ ♊ , 1.2α♎οπ ♌, im♍ , κλ♏ , ϱ Oph. , 1.2μd ♐ , β ♍, ,
0 , δ♌ , 2κιζ ♉ , νζ ♊ , 1.2α♎οπ ♌, αim♍ , κλ ♏, βm ϱ Oph. , 1.2μd ♐ , β♍, ,

♋ in m, VII[s].

27° ζ♓, δ♌, 2κιζ ♉ , ν ♊ , 1.2α♎οπ ♌ , αim♍, κλ♏, βνm, ϱ Oph. 1.2μd ♐ , β♍, ,
24 ζ♓, , ιζ ♉ , ν ♊ , 1.2α♎οπ ♌, , αim♍ , κλ♏, βνm ϱ Oph. , 1.2μd ♐ , β♍, ,
21 ζ♓, , ιζ ♉ , ν ♊ , 1.2α♎οπ, υ ♌, αim♍, ακλ♏, βνm ϱ Oph. , 1,2μd ♐ , β ♍, ,
18 ζ♓ , , ειζ ♉ , ν ♊ , 1.2α♎οπ, υ ♌, αim♍, ακλ♏, βνm ϱ Oph. , 1,2μd ♐ , β ♍
15 ζ♓ , , ειζ ♉ , ν ♊ , 1.2α♎οπ, υ ♌, αm♍, ακλ♏, βνm ϱ Oph. , 1.2μd ♐ , β♍, ,
12 εζ♓ , , εζ ♉ , ν ♊ , 1.2α♎οπ, υ ♌, α, λm♍ακλ♏, βνm ϱ Oph. , 2μd ♐ , β♍, ,
9 εζ♓, , εζ ♉ , ν ♊ , 1.2α♎οπ, υ ♌ , α, λm♍α4ζ♏, βνm ϱ Oph. , 2μd ♐ , β♍, ,
6 εζ♓, , ε ♉ , , ν ♊ , 1.2α♎οπ, υ ♌, α, λm♍α4ζ♏, βνm, , β ♍, ,

3 εζ♓, , ε♉, , 1.2α♋οπ, υ♌, α, λ♍α4ζ♎, βν♏, , β♑, ,
0 εζ♓, , 1δε♉, , 1.2α♋οπ, υ♌, α, λ♍α4ζϑ♎, ν♏, , β♑, ,

☊ ☊ in ♎, VI^s.

27° ε♓, , 1.2δε♉, , 1.2α♋οπ, υ♌, , λ♍α4ζϑ♎, ν♏, , β♑, ,
24 ε♓, , 1.2δε♉, , 1.2α♋οπ, υ♌, , λ♍α4ζϑ♎, , , β♑, ,
21 ε♓, , 1.2δε♉, , 1.2α♋οπ, υ♌, λ♍4ζϑ♎, , , β♑, ϑ♒
18 ε0♓, , 1.2δε♉, , 1.2α♋ξοπ, υ♌, , λ♍4ζϑ♎, , , β♑, ϑ♒
15 ε0♓, , 1.2δε♉, , 1.2α♋ξοπ, υ♌, , λ♍4ζϑ♎, , , β♑, ϑ♒
12 0♓, , 1.2δ♉, , 1.2α♋ξοπ♌, , , κ♍, 4ζγϑ♎, φ Oph., , β♑, ϑ♒
9 0♓, , 1.2δα♉, , 1.2α♋ξοπ, τ♌, ϑ, κ♍, 4ζγϑ♎. φ Oph., β♑, ϑ♒
6 0♓, , 1.2δα♉, 1.2α♋ξοπ, τ♌, ϑ, κ♍, γϑ♎, φ Oph., , β♑, ϑ♒
3 0♓, , 1.2δα♉, , 1.2α♋ξοπ, τ♌, ϑ, κ♍, γϑ♎, φ Oph., β♑ ϑ♒
0 0♓, , 1.2δα♉, , ξοπ, τ♌β, ηϑ, κ♍, γϑ♎, φ Oph., , β♑, ϑ♒

☊ ☊ in ♍, V^s.

27° 0♓, , γ1.2δα♉, , ξ0, τ♌β, ηϑ, κ♍γϑ♎, φ Oph., , β♑, ϑ♒
24 0♓, , γ1.2δα♉, , ξ0, τ♌β, ηϑ, κ♍γϑ♎, φ Oph., , β♑, ϑ♒
21 0♓, , γ1.2δα♉, , ξ0, τ♌β, ηϑ, κ♍γϑ♎, φ Oph., d ♐, β♑, ϑ♒
18 , , γ1.2δα♉, , ξ, , τ♌β, ηϑ, κ♍γϑ♎, φ Oph., d ♐, β♑, ϑλ♒
15 , , γ1.2δα♉, , ξ, ετ♌β, ηγϑ, κ♍γϑ♎, φ Oph., d ♐, β♑, λφ♒
12 , , γ1.2δα♉, , ξ, ετ♌β, ηγϑ, κ♍γ♎, φ Oph., d ♐, , λφ♒
9 ν♓, μ Cet., γ1.2δα♉, , , εσ♌β, ηγ, κ♍γψ♎, φ Oph., d ♐, , λφ♒
6 ν♓, μ Cet., γ1.2δα♉, , α, εσ♌β, ηγ, κ♍ γψ♎, φ Oph. d ♐, , λφ♒
3 ν♓, μ Cet., γ1.2δα♉, ν♊, α, εσ♌β, ηγ♍, γψ♎, φ Oph., d ♐, , λφ♒
0 ν♓, μ Cet., 1.2δα♉, ν♊, α, εσ♌, ηγ♍, γψ♎, φ Oph., d ♐, , λφ♒

☊ ☊ in ♌, IV^s.

27° νη♓, 2ξμ Cet., γ1.2δα♉, ν♊, α, εσ♌, γ♍, γψ♎, φ Oph., d ♐, , λφ♒
24 νη♓, 2ξμ Cet., γ1.2δα♉, νζ♊, α, εσ♌, γ♍, γψ♎, φ Oph., d ♐, , λφ♒

21 νη♐, 2ξμ Cet., γ1.2δα ♉, νζ♊, α, ρσ♌, γ♍, γψ♎, φ Oph., 2μd ♐, λφ♒

18 νη♐, 2ξμ Cet., γ1.2δα ♉, νζ♊, δ♋α, ρσ♌, γ♍, γψ♎, φ Oph. 2μd ♐, ϑ♈, φ♒

15 νη♐, 2ξμ Cet., γ1.2δα ♉, νζ♊, δ♋α, σ♌, γ♍, γ♎, φ Oph., 2μπd ♐, ϑ♈, ,

12 νη♐, 2ξμ Cet., γ1.2δα ♉, νζκ♊, δ♋α, σ♌, γ♍, γ♎, φ Oph., 2μπd ♐, ϑ♈, ,

9 νη♐, 2ξμ Cet. γ1.2δα ♉, νζκ♊, δ♋α♌, , , γϑ♎, φ Oph., 2μϑ ♐, ϑ♈, ,

6 νη♐, 2ξμ Cet., 1.2δαζ♉, νζκ♊, δ♋α♌, , , γϑ♎, φ Oph., 2μοπ ♐, ϑ♈, ,

3 νη♐, 2ξμ Cet., 1.2δζ♉, νζδκ♊, δ♋, , , γϑ♎, φ Oph., 2μοπ ♐, ϑγ♈, ,

0 νη♐, 2ξμ Cet., 1.2δζ♉, νζδκ♊, δ♋, , , γϑ♎, φ Oph., 2μοπ ♐, ϑγ♈, ,

♉ in ♋, III^s.

27° νη♐, 2ξμ Cet., 1.2δζ♉, ηνζδκ♊, δ♋, , , γϑ♎, ρ Oph., 2μοπ ♐, ϑγ♈, ,

24 νη♐, 2ξμ Cet., 1.2δεζ♉, ηζδκ♊, δ♋, , , γϑ♎, ρ Oph., 2μ1νοπ ♐, ϑγ♈, ,

21 νη♐, 2ξμ Cet., 1.2δεζ♉, ηζδκ♊, δ♋, , , γϑ♎, ρ Oph., 2μ1νοπ ♐, ϑγ♈, ,

18 νη♐, 2ξμ Cet., 1.2δεζ♉, ηδκ♊, , , , γϑ♎, ρ Oph., 2μ1νοπ ♐, γ♈, ,

15 νη♐, 2ξμ Cet., 1.2δεζ♉, ηδκ♊, , , , γϑ♎, ρ Oph., 1νο ♐, γ♈, ,

12 νη♐, μ Cet., 1.2δειζ♉, ηδκ♊, , , , γϑ♎, ρ Oph., 1νο ♐, γ♈, ,

9 νη♐, μ Cet., 1δειζ♉, ηδκ♊, η♌, , , γϑ♎, ρ Oph., 1νο ♐, γ♈, ,

6 νη♐, , ειζ♉, ηδκ♊, η♌, , , 4ζγϑ♎, ν♏ ρ Oph., 1ν ♐, γ♈

3 νη♐, ει♉, ηκ♊, η♌, , , 4ζγϑ♎, ν♏ ρ Oph., 1ν ♐, γ♈, 2τ♒

0 νη♐, , ει♉, ηκ♊, η♌, , , 4ζϑ♎, ν♏ ρ Oph., 1ν ♐, ε♈, 2τ♒

♉ in ♊, II^s.

27° νη♐, , ει132♉, ηεκ♊, γ♋η, ι♌, , κ♍4ζϑ♎, βν♏, 1ν ♐, ε♈, 2τ♒

24 νη♐, , ει132♉, εκ♊, γ♋η, ι♌, , κ♍4ζϑ♎, βν♏, λψ ♐, ε♈, 2τ♒

21 νη♐, , ι132♉, εκ♊, γ♋η, ι♌, , κ♍4ζ♎, βν♏ B Oph., λψ ♐, ε♈, 2τ♒

18 νϡ, , ι132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍4ζ♎, βν♏ B Oph., λψ ♐, ε♑, 2τ♒

15 νϡ, , ι132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍4ζ♎, βν♏ B Oph., λσψ ♐, ε♑, 2τ♒

12 νϡ, , 2κ132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍4ζλ♎, βν♏ ϑ B Oph., λσψ ♐, ε♑, 2τ♒

9 νϡ, , 2κ132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍4ζκλ♎, βν♏ ϑB Oph., λσψ ♐, ε♑, 2τ♒

6 , , 2κ132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍4ζκλ♎, β♏ ϑB Oph., λσψ ♐, ε♑, 2τ♒

3 , , 2κ132 ϐ, εκ Π, γ♋η, ι Ω, , κ♍ κλ♎, β♏ ϑ B Oph., λσψ ♐, ε♑, 2τ♒

0 οϡ, , A2κ132 ϐ, εκ Π, η Ω, , γ, κ♍ ακλ♎, β♏ ϑ B Oph., λσψ ♐, ε♑, 2τ♒

ϐ in ϐ, 1ˢ.

27° οϡ, , A2κ132 ϐ, ευκ Π, η Ω, γ, κ♍ακλ♎, ϑ B Oph., λσψ ♐, ε♑, 2τ♒

24, οϡ, , A2κ ϐ, υκ Π, η Ω, γ,κλ♍ακλ♎, ϑ B Oph., λσψ ♐, ε♑, 2τ♒

21 οϡ, , A2κ ϐ, υ Π, η Ω, γϑ, λ♍ακλ♎ δ♏, Aϑ Oph., στψ ♐, ε♑, 2τ♒

18 οϡ, , A2κ ϐ, υ Π, η Ω, γϑ, λ♍ακλ♎ δ♏, Aϑ Oph., στ ♐, ε♑, 2τ♒

15 οϡ, ,A2κ ϐ, υ Π, η Ω, γϑ, λ♍ακλ♎ δ♏, Aϑ Oph., στ ♐, ε♑, 2τ♒

12 οϡ, , A ϐ, ιυ Π, η Ω, γϑ, λ♍ακ♎ δ♏, Aϑ Oph. στ ♐, ε♑, 2τ♒

9 οϡ, δ♈, A ϐ, ιυ Π, η Ω, γϑ, λ♍α♎ δ♏, A Oph. στ ♐, ε♑, 2τ♒

6 οϡ, δ♈, A ϐ, ιυ Π, η Ω, γϑ, λ♍α♎ δ♏, A Oph. στ ♐, ε♑, ,

3 ζοϡ, δ♈, A ϐ, ιυ Π, η Ω, ηγϑ, λ♍α♎ δ♏, A Oph., στ ♐, ε♑, ,

0 ζοϡ, δ♈, . ιυ Π, η Ω, ηγϑ, λ♍δ, σ♏ A Oph. τ ♐, ε♑, ,

ϐ in ♈. 0ˢ.

27° ζϡ, δ♈, , ιυ Π, η Ω, , ηγϑ,λ♍δ, σ♏ A Oph., τb ♐, ε♑, ,

24 ζϡ, δ♈, β ϐ, ιυ Π, η Ω, , ηϑ♍, δ, σα♏ A Oph., τb ♐, ε♑, ,

21 ζϡ, δ♈, ηβ ϐ, ιυ Π, η, σ Ω, ηϑ♍,δ, σα♏ A Oph. τb ♐, ε♑, ,

18 ζϡ, δ♈, ηβ ϐ, ιυ Π, η, σ Ω, η♍, , σα♏ A Oph., τb ♐, ε♑, ,

15 εζϡ, δ♈, ηβ ϐ, ιυ Π, η, σ Ω β, η♍, , σα♏ A Oph., τ ♐, ε♑, ,

12 εζϡ, δ♈, ηβ ϐ, κAur. ιυ Π, η, σ Ω β, ηα♍, , σα♏ A Oph., τ ♐, ε♑, ,

9 ε♓, , ηβ♉, κAur. ιυ♊, , σ♌β, ηα♍, , σα♏ A Oph. τ♐,
εδ♑, ,

6 ε♓, , ηβ♉, κAur. ιυ♊, γ♋, σ♌β, ηα♍, , σα♏, δτ♐, εγδ♑, ,

3 ε♓, , ηβ♉, κAur. ιυ♊, γ♋, σ♌β, α♍, π♏, σα♏, δτ♐,
γδ♑, ,

0 ε♓, , ηβ♉, κAur. ιυ♊, γ♋, σ♌β, α♍, π♏, σα♏, δτ♐,
γδ♑, ,

4. Explanation *of the Second* Table.

The method of computing the solar nutation, to which these tables are adapted, is neither altogether new, nor always the most convenient: but for the places of single stars, in cases like the present, it possesses some advantages, and may therefore deserve to be further explained and demonstrated, notwithstanding the trifling magnitude of the correction.

The formula employed by Bessel for the right ascension is — ta δ ($''$,3982 sin α sin 2 $\odot$ + $''$,434 cos α cos 2 $\odot$) — $''$.9173 sin 2 $\odot$; and for the declination, — $''$,3982 cos α sin 2 $\odot$ + $''$,434 sin α cos 2 $\odot$. But it is known, that in general $a \sin x + b \cos x = \sqrt{(a^2 + b^2)} \sin \left(x + \text{ang ta} \frac{b}{a}\right)$. (M. E. §.216): and for the right ascension we have $a = -\text{ta}\,\delta\,.3982 \sin\alpha - .9173$, and $b = -\text{ta}\,\delta\,.434 \cos\alpha$, and ang ta $\frac{b}{a}$ = ang cot $\frac{a}{b}$ = ang cot $\left(\frac{.3982}{.434}\text{ ta }\alpha + \frac{.9173}{.434}\cot\delta\sec.\alpha\right)$ = ang cot .9175 (ta α + 2.3036 cot δ sec α): and this angle being found, the factor $\sqrt{(a^2 + b^2)}$ will be obviously equal to its cosecant multiplied by b, or by $-.434$ ta δ cos α. In the same manner we obtain for the declination $a = -.3982 \cos\alpha$, and $b = +.434 \sin\alpha$, and ang ta $\frac{b}{a}$ = ang ta $-\frac{.434}{.3982}$ ta α = ang ta (-1.0900 ta α): the cosecant being again multiplied by $b = .434 \sin\alpha$, for the factor.

Taking, for an example, the first star of the table, ε ♓, we have $\alpha = 0^{\text{H}}\ 53^{\text{M}}\ 36^{\text{S}},5 = 13^\circ\ 24'$ and $\delta = +6^\circ\ 55'\ (11'')$ whence nat. ta α = .2382, log ta α = 9.3770 log sec α = .0120

log cos α = 9.9880, log sin α 9.3650, log cot δ .9161, and log ta 9.0839 : then

	AR.			Declination.
Log	2.3036	.3624	Log 1.0900	.0374
	Cot δ	.9161	ta α	9.3770
	Sec α	.0120		
	N 19.522	1.2905	L. ta 14° 33′	9.4144
	.2382		cosec	.6000
N. ta α			.434	9.6375
	19.7602	1.2958	sin α	9.3650
Log	.9175	9.9626		
			factor +	9.6025
L cot	3° 9′	1.2584		
	cosec	1.2590		
	.434	9.6375		
	ta δ	9.0839		
	cos α	9.9880		
L. factor (—)		9.9684		

The factor for the AR. being negative, we add 6 signs to the angle, in order that the signs of the sines may be inverted, and we have 6^s 3° 9′ for the angle. The angles never varying much from those which belong to the lunar nutation, the two series serve as checks on each other in the computation. For reducing the factors into time we subtract log 15 = 1.1761, or add 8.4614, instead of 9.6375. The angle for correcting the declination is 14° 33′, but the tangent being negative, the true angle to be employed is 12^s—(14° 33′) or 6^s—(14° 33′), since the tangents are the same for opposite points of the circle: and by reverting to the original expression, we shall find that the latter must be taken in this case: but for the correction of the N. P. D. we take the former, when the declination is north, in order to change the sign of the sine. The factor for the declination is nearly constant for all the stars, and may safely be assumed 9.62, which is equivalent to ″,4 or ″,41 for the whole table, the error seldom amounting to so much as ″,01.

5. *Computation of the Elements for an Almanac.*

i. With the longitude of the moon's node for the beginning and end of each lunation, enter the first table, and put down all the stars liable to occultation at either place of the node, for further examination.

Example. In February, 1822, the node recedes from 10^s 26° 5′ to 10^s 24° 49′, and the stars liable to occultation are, ηfβ ♉, κΠ, αξυ♌, i♍, πσατ♏, A Ophiuchi, σψ♐, ϑ♑.

ii. Find, by inspection of the moon's right ascension, the day on which the conjunction with each of these stars will take place, and compute the corrections from the sun's longitude and the place of the node on that day.

Example. Taking υ♌, of which the AR. in space is 171° 56′, we find that the occultation will happen on the 8th, a little before midnight, when the sun's longitude is 10^s 19° 44′, and that of the ☊ 10^s 25° 41′. The time from 1st Jan. 1820 is $2\frac{1}{9.4}$ years, whence the precession is + 6^s,47 and + 41″,9. For the aberration, we add 3^s 9° 0′ and 3^s 0° 44′ to the ☉'s longitude, making 13^s 28° 44′ and 13^s 20° 28′, and the logarithmic sine of + 58° 44′ being 9.9318, this being added to .0935 gives .0253, or + 1^s,06, for the correction in AR.; and in the same manner L. sin 50° 28′, or 9.8872, added to .9058, gives .7930 or + 6″,2 for the correction of the N. P. D. The arguments for the solar nutation are 5^s 29° 56′, and 6^s 8° 47′ to which we add 2^s, 9° 28′, making 27^s 9° 24′, or 3^s 9° 24′, the sine of which is the cosine of 9° 24′, and 9.9941 + 8.785 = 8.779, giving + ^{s},06 for the AR.; and 27^s 18° 15′ gives us 9.978 + 9.62 = 9.60, and the correction for the N. P. D. is ″,4. The lunar nutation is found from the arguments 5^s 29° 50′ and 6^s 11° 13′, making with 10^s 25° 41′, 16^s 25° 31′ and 17^s 6° 54′, of which the logarithmic sines are 9.753 and 9.594, to be added to .0426 and .8602, making 9.797 and .454, and giving + ^{s},62 and + 2″,8 for the lunar nutations. The result of the whole is,

υ ☊	11^H	27^M	$43^s,87$ AR.		N. P. D.	89°	49′	48″1
+			6,47		+			41,9
+			1,06		+			6,2
+			,06		+			,4
+			,62		+			2,8
	11	27	52,08			89	50	39,4
Or,	171°	58′	1″,2		Decl.	0	9	20,6 N

iii. Find by inspection of the moon's right ascension, the hour in which the occultation is likely to happen, and compute, by means of first and second differences, the moon's change of right ascension and of declination for that hour.

Example. In the *Connaissance des Tems* for 1822, the right ascensions stand thus:

					1 Diff.			2 Diff.		Mean.	
7	M	161°	10′	12″							
8	N	166	52	41	+ 5°	42′	29″	— 6′	13″		
	M	172	28	57	5	36	16	4	14	— 5′	13″
9	N	178	0	59	5	32	2				

Hence it appears, that the occultation will happen about 11 o'clock on the 8th: the change in an hour is 28′ 1″,3 besides the second difference, which at 11^H is 12″, leaving 27′ 49″,3 for the change from 11 to 12. The declinations are,

					1 Diff.			2 Diff.		Mean
7	M	6°	30′	22″						
8	N	3	32	35	N 2°	57′	47″	— 0′	5″	
	M	0	34	53	2	57	42	1	43	— 54″
9	N	—2	21	6	2	55	59			

Consequently we have 14′ 48″,5 for each hour, and 2″,1 for the second difference at 11^H, leaving 14′ 46″,4 for the change in the last hour.

iv. To the proportional logarithm of the hourly change of right ascension, add the logarithmic secant of the declination; subtract the sum from the proportional logarithm of the change of declination, and find the angle of which the difference is the tangent, for the polar orbital angle, agreeing nearly with the angle appropriate to the star in the second table.

Example.	Prop. Log. 27′ 49″,3	.8109
	Log. sec. 0° 35′	.0000
		.8109
	P. L. 14′ 46″,4	1.0858
	Log. ta 62° 2′	0.2749

v. The logarithmic cosine of this orbital angle added to the proportional logarithm of the hourly motion in declination will give the hourly motion in the orbit, differing but little from the hourly change of longitude.

Example.	Log. cos. 62° 2′	9.6711
	P. L.	1.0858
	P. L. 31′ 30″,3	0.7569

We therefore write ☽'s H. M. 31′ 30″, S. 62° 2′ E.

vi. It will also be necessary to find the difference of declination at the time of the conjunction in right ascension, since this element will be required for the subsequent computation with regard to any particular observation.

Example. The moon's AR. at 11^H is 172° 1′ 7″,7, that is, 3′ 6″,5 beyond the star; then

As 27′ 49″,3	P. L. A. C.	1892	Again, as 1^H	P.L. A.C.	5229
To 1^H	P. L.	4771	To 6^M 42^S	P. L.	1.4290
So is 3′ 6″,5	P. L.	1.7627	So is 14′ 46″,4		1.0858
To 6^M 42^S		1.4290	To 1′ 39″		2.0377

Now the declination at 11^H is 49′ 39″,4, and consequently at 10^H 53^M 18^S, 51′ 18″,4, which exceeds that of the star, 9′ 20″,6 by 41′ 57″,8, the difference of declination. We therefore write 1822, Feb. 8, ☽ ☍ ☊, ☌ in AR. 10^H 53^M 18^S, ☽ 41′ 57″,8 N.

6. *Computation of a visible Occultation.*

i. Find the moon's altitude for the instant of conjunction in right ascension, and for an hour earlier or later, and compute the parallactic angle, formed by the circle of declination with the vertical circle: this angle subtracted from the *polar orbital*

angle, given by the previous computation, or added to it, according to the relative situation of the angles, will give the *parallactic orbital angle*, formed by the orbit with the vertical circle.

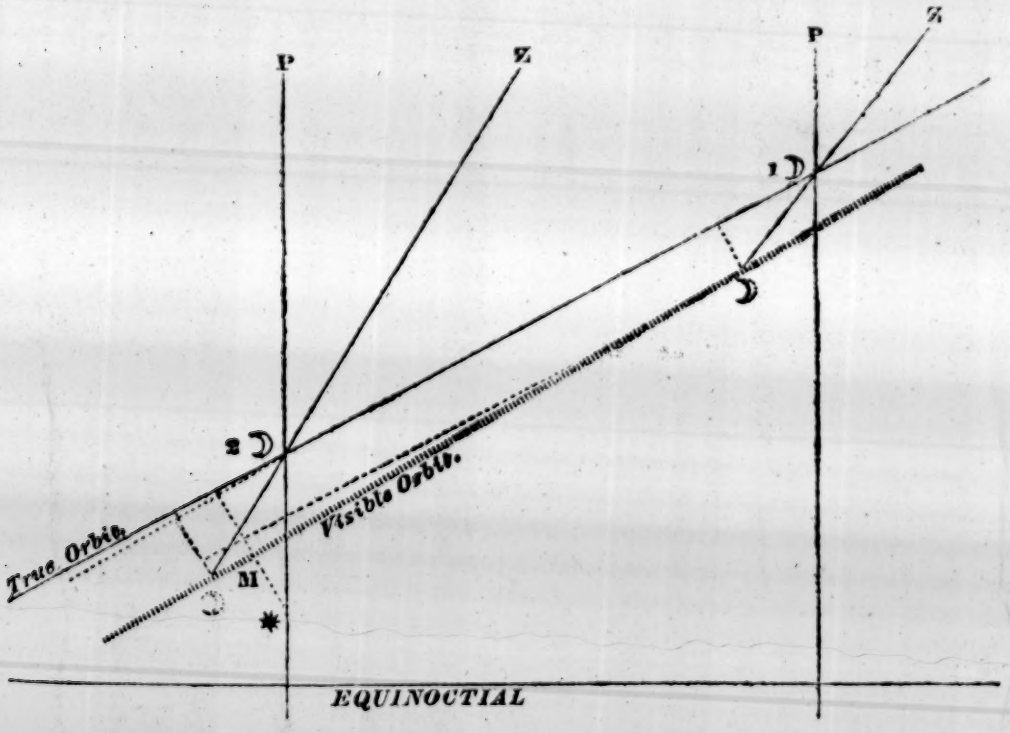
Example. In the case of the occultation of υ ♌, since the moon passes the meridian of Paris on the night of the 8th of February, at $14^H\ 5^M$, it is obvious that she will be in the east at 11^H, and that the depression by parallax will accelerate the occultation. We therefore calculate the altitude for $10^H\ 53^M\ 18^S$ the time of conjunction, and for $9^H\ 53^M\ 18^S$. Now, the moon's right ascension, in the former case, is 171° 58′ 1″, or $11^H\ 27^M\ 52^S$, in the latter 171° 30′ 9″, or $11^H\ 26^M\ 1^S$: the sun's $21^H\ 28^M\ 26^S$ and $21^H\ 28^M\ 16^S$ respectively: the differences $10^H\ 0^M\ 34^S$, and $10^H\ 2^M\ 15^S$, added to the sun's horary angles, make $20^H\ 53^M\ 52^S$, and $19^H\ 55^M\ 33^S$ W., or $3^H\ 6^M\ 8^S$ and $4^H\ 4^M\ 27^S$ E., for the moon's horary angles: and her declinations are 51′ 19″ and 1° 6′ 6″ N. Then from the Requisite Tables, XVI., we have

1. Log rising		4.49425	2. Log rising		4.71336
L. cos 48° 50′ 14″		9.81835			9.81835
51′ 19″		9.99995	cos 1° 6′ 6″		9.99992
n 20538		4.31255	n 34012		4.53163
N.S. 66937	Mer A. 42° 1′ 5″		N.S. 67255	M.A. 42° 15′ 52″	
N.S. 46399	Alt 27 38 42		N.S. 33243	Alt. 19 25 0	
L. sec. Alt		.05264			.02543
sin H. A. 46° 32′		9.86080	L. sin 61° 7′		9.94229
cos lat		9.81835			9.81835
sin P. A. 32° 38′		9.73179	37° 40′		9.78607

Now the moon being east of the meridian, the vertical circle passes upwards to the west of the circle of declination, and downwards to the S. E., so that the parallactic angles must be subtracted from 62° 2′ the angle S. E. of the moon's orbit, thus,

	62° 2′	62° 2′
	− 32 38	37 40
Par. orb. angle	29 24	24 22

ii. To the proportional logarithm of the horizontal parallax, properly reduced, add the logarithmic secant of the apparent altitude, obtained from the approximate parallax in altitude; and first the secant and then the cosecant of the parallactic orbital angle in each position. The first results will give the parallax reduced to the true orbit, and their difference will give the correction of the hourly motion in the orbit. The difference of the second results will be the tangent of the angular correction, if the corrected hourly motion be made radius.



Example. The proportional logarithm of the equatorial parallax at 12^H is 5092, increasing to 5115 in 12 hours; consequently at 10^H 53^M it is 5090, at 9^H 53^M, 5088, and adding 8 for the ellipticity, since the latitude is between 47° and 51° (Astr. Coll. II. ii. XIII.), we have 5098 and 5096. Then

P. L.		5098		5096
Log sec	27° 39′	.0527	19° 25′	.0254
P. L.	49′ 18″	5625	52′ 31″	5350
Log sec	26° 49′ 42″	.0495	18° 32′ 29″	.0231
P. L.		5593		5327
Log sec	29° 24′	.0599	24° 22′	.0405
P. L.	43′ 15″	6192	48′ 6″	.5732
Log cosec	29° 24′	3090	24° 22′	.3845
P. L.	24′ 23″	8683	21′ 47″	9172

The differences are 4′ 51″ and 2′ 36″, and the hourly motion becomes 26′ 39″, instead of 31′ 30″; hence

P. L.	26′ 39″	8296	
	2′ 36″	1.8403	
Log tang	5° 34′	8.9893	
	62 2		
	56 28		Visible polar orbital angle.
	29 24		
	23 50		Visible parallactic orbital angle.

iii. By means of the angles thus found, reduce the parallax at the conjunction in right ascension to the visible orbit, and to the direction perpendicular to it; and reduce the difference in declination to the same directions; the sum or difference of the former results, reduced into time, according to the visible hourly motion, will give the time of the nearest approach and the sum or difference of the latter will give the nearest distance. The hourly motion may be reduced to the visible orbit by increasing it in the ratio of the radius to the secant of deviation.

Example.

P. L. par in alt.	5593	P. L. H. M.	8296
Log sec 23° 49′	.0387	Log sec 5° 36′	.0021
P. L. 45′ 26″	5980	P. L. corr. H. M.	8275
		P. L. 1^{H}	4771
Log cosec 23° 50′	3935		
			3504
P. L. 20′ 4″	9528	P. L. 22′ 14″	9083
P. L. diff. decl. 41′ 58″	6324	P. L. 49^{M} 49^{S}	5579
Log sec 56° 28′	2577	10 53 18	
P. L. 23′ 11″	8901	10 3 29 Middle.	
Log cosec 56° 28′	.0791		
P. L. 34′ 59″	7115		

45′ 25″	34′ 59″	
23 11	20 4	
22 14	14 55	Nearest distance.

iv. It may be necessary, in some cases, to repeat the calculation of the effect of parallax at the time thus found, in order that the true visible motion during the interval may be employed, instead of the hourly motion, and the calculations of the two last precepts may be repeated with the correction of the visible orbit thus obtained: or the whole computation may be verified by any of the common methods. The nearest distance, compared with the moon's apparent diameter corrected for the altitude, readily gives the length of the star's path behind the moon, and the visible hourly motion the corresponding time.

Example. Supposing 14′ 55″ the correct distance, the moon's semidiameter being 15′ 16″ at noon, and diminishing 9″ in 24 hours, it will be 15′ 12″ at 10^{H}, and the augmentation for altitude 21° being 6″, we have 15′ 18″ for the corrected semidiameter.

Dist.	14′ 55″		
Semid.	15 18		
Sum	30 13	P. L.	.7750
Diff.	23	P. L.	2.6717
			3.4467
		Half sum	1.7233
P. L. for		H. M.	3504
P. L. semiduration		7^M 38^s	1.3729
	10 3 29		
Immersion	9 55 51;	10^H 11^M 7^s Emersion.	

The *Connaissance des Tems* makes the distance $14'\frac{1}{2}$, and the whole duration 10^M only.

ii. ERRORS *of the* LUNAR TABLES; *deduced from* 4068 *Observations, computed by order of the* BOARD OF LONGITUDE.

MAYER and MASON.	Mean Error. Long.	Mean Error. Lat.	Greatest Error. Long.	Greatest Error. Lat.
1783	± 23″,7	18″,8	67″,2	74″,0
1784	25,5	14,0	61,9	49,8
1785	35,6	13,0	72,6	44,4
1786	28,2	14,7	69,3	65,4
1787	30,5	13,0	86,5	111,5
1788	38,8	13,1	89,7	114,5
MASON.				
1789	28,9	7,4	61,2	57,1
1790	28,4	6,7	52,2	28,0
1791	28,4	7,0	70,7	53,8
1792	24,8	6,8	50,7	21,8
1793	24,7	10,2	51,3	41,1
1794	21,0	11,4	56,9	39,2
1795	24,9	13,4	60,0	56,6
1796	24,5	15,6	54,5	27,5
1797	25,0	16,6	53,8	80,4
1798	23,0	16,5	56,9	57,6
1799	25,8	19,4	58,3	58,3
1800	27,0	17,7	55,3	56,0
1801	30,9	17,4	65,4	54,6
1802	32,1	17,5	64,1	79,6
1803	34,6	16,8	86,7	76,5
1804	36,0	10,1	67,0	43,1
LAPLACE and MASON.				
1805	+ 34,1 − 0,0	8,3	61,1	30,4
1806	+ 36,7 − 0,0	11,1	67,6	41,0

	Mean Error. Long.	Mean Error. Lat.	Greatest Error. Long.	Greatest Error. Lat.
1807	± 27″,3 + 25,5	7″,8	55″,5	36″,4
1808	± 26,7 + 25,7	6,0	59,9	32,7
1809	± 8,1	5,3	36,6	30,9
1810	± 7,4	7,2	25,5	35,2
1811	± 7,0	9,6	19,5	43,4
1812	± 8,8	10,2	28,7	34,8
LAPL. and BURG.				
1813	± 6,5	8,3	17,2 3; 15,2*	31,7
1814	± 5,1	7,7	20,8 3; 12,3*	30,9
1815	± 4,8	6,3	34,3 3; 13,4*	23,7
1816	± 5,6	6,5	24,5 3; 17,0*	18,0
1817	± 5,3 − 0,5	6,7	15,1 3; 10,4*	20,1
1818	± 6,4 − 2,3	6,7	16,3 3; 13,6*	29,5
1819	± 6,1 − ,2	7,0	27,6 3; 13,8*	24,7
LAPL. and BURCKHARDT.				
1817	± 4,7 + 3,1	4,7	13,7 3; 11,2*	13,5
1818	± 5,0 + 2,3	5,2	21,4 3; 14,5*	25,5
1819	± 4,5 + 3,0	4,6	22,3 3; 12,5*	20,3

* Greatest mean of three consecutive errors.

Art. XIV. *Miscellaneous Intelligence.*

I. Mechanical Science.

§ Optics, the Arts, &c.

1. *On the Structure of the Diamond.*—Whilst making experiments on the optical structure of amber, Dr. Brewster was led to compare it with the diamond. He found some singular analogies in the two substances, but one diamond which he examined presented a new phænomenon of a most unexpected kind, which Dr. Brewster observes, is the only fact in the natural history of this body that promises to throw light upon its origin and mode of formation. The same phænomenon occurs also with amber. It is "the existence of small portions of air within both substances, the expansive force of which has communicated a polarizing structure to the parts in immediate contact with the air. This structure is displayed by four sectors of polarized light encircling the globule of air, and can be produced artificially either in glass or in gelatinous masses, by a compressing force, propagated circularly from a point. It is obvious that such an effect cannot arise from any mode of crystallization; and if any proof of this were necessary, it might be sufficient to state, that I have never observed the slightest trace of it in more than 200 mineral substances which I have examined, nor in any of the artificial salts formed from aqueous solutions. It can, therefore, arise only from the expansive force exerted by the included air on the *diamond* and the *amber*, when *they were in such a soft state as to be susceptible of compression from so small a force.* That this compressible state of the diamond could not arise from the action of heat is manifest from the nature and the recent formation of the soil in which it is found; that it could not exist in a mass formed by aqueous deposition is still more obvious; and hence we are led to the conclusion, rendered probable by other analogies, that the *diamond* originates like amber from the consolidation of, perhaps, vegetable matter, which gradually acquires a crystalline form by the influence of time, and the slow action of corpuscular forces."

These results were obtained with flat diamonds regularly crystallized, but on examining Mr. Allan's collection, Dr. Brewster found one of a perfectly octoëdral form, having the same structure, and containing also an air-bubble of considerable size, which had produced, by its expansion, the polarizing structure already described. *Edin. Phil. Journal,* iii. p. 98.

2. *Optico-Meteorological Question.*—The following subject has been given by the class of mathematics in the Royal Academy of Sciences of Prussia:

"To give a mathematical explanation of the luminous and coloured crowns, which are observed at times round the sun and moon, conformable to experiments on light and the constitution of the atmosphere, and in accordance with observations of the phænomena made with as much precision as possible."

Mémoires cannot be received after March, 1822. The prize is fifty ducats, and will be adjudged at the public sitting, on the anniversary of Leibnitz, on the 3d of July following.

3. *Double Refraction of Minerals.*—The means of ascertaining the double refraction of substances are very simple; the two following are quoted by M. Soret:—"Two plates of tourmaline, cut parallel to the axis of the crystal, and placed crossways, so as to absorb all the light, form the apparatus. The substance to be examined is to be placed between the plates; if it is doubly refractive, the light re-appears through the tourmalines; if not, all remains dark."

The other method is to place the crystal to be examined over a hole in a card, and examine the light transmitted through it by an achromatic prism of Iceland spar. If the two images produced are differently coloured it indicates double refraction. *Journal de Physique,* xc. p. 353.

4. *Restoration of the White in Painting.*—M. Thenard has lately applied his oxygenated water with great success to the arts. It is constantly happening in paintings where the white used is prepared from lead, that sulphurous vapours change the

tint, and render it brown or black. Paintings of the first masters are frequently injured in consequence of this effect, being blotted, as it were, with spots of colour, which spoil the effect. An artist at Paris, who possessed a design of Raphael's thus disfigured, and who was too careful of the original work to re-paint the places, applied to M. Thenard for chemical assistance. That chemist during his attempts, remembering the effect of oxygenated water in converting the black sulphuret of lead into a white sulphate, sent some water, very slightly oxygenated, to the artist, who, by applying it with a pencil, instantly removed the spots, and restored the white. The fluid was so weak as to contain not more than five or six times its volume of oxygen, and had no taste. Paper coloured by a slight tint of bistre was not at all altered by it.—*Annales de Chimie*, xiv. p. 221.

5. *Distant Visibility of Mountains.*

	Authorities.	Distance in Miles.
Himáláya mountains.....	Sir W. Jones	244
Mount Ararat, from Derbhend.....	Bruce	240
Mowna Roa, Sandwich Isles (53 leagues)		180
Chimborazo (47 leagues)		160
Peak of Teneriffe from South Cape of Lanzerota		135
Peak of Teneriffe from ship's deck....		115
Peak of the Azores	Don M. Cagigal	126
Temaheud	Morier	100
Mount Athos	Dr. Clarke	100
Adam's Peak		95
Ghaut at the back of Tellichery		94
Golden Mount from ship's deck		93
Pulo Pera from the top of Penang ..		75
The Ghaut at Cape Comorin		73
Pulo Penang from ship's deck		53

The last six observations, and that of the Peak of Teneriffe, were made by a writer in the *Calcutta Monthly Journal.* The first of the Peak of Teneriffe is from *Humboldt's Personal Nar-*

rative, i. p. 98. The Peak of the Azores from the same volume, p. 99, note. *Edin. Phil. Journal*, iii. p. 192.

6. *Earthen-ware Reflectors.*

To the EDITOR *of the* QUARTERLY JOURNAL *of* SCIENCE, *&c.*

SIR—I have great pleasure in informing you, that we have adopted some of the reflectors proposed by Mr. Millington, and described in your fifth volume, to the gas lamps in our city, and find them attended with such advantages, as to induce me to write to you on the present occasion. They are made of earthen-ware, with the common white glaze, are about eleven inches diameter, and cost about seven shillings a dozen. They not only considerably increase the light, but materially contribute to the protection of the head of the lamp, by preventing its being unsoldered, or injured, by the flame; and I am persuaded, that if known, they would be duly appreciated, and generally adopted. I am, Sir, yours sincerely,

CHARLES WILKINSON.

Bath, April 20, 1820.

7. *Gas Tube.*—Mr. Phipson, of Birmingham, in order to obviate the effects produced by the action of gases on copper or brass pipes, through which they pass, has adopted the plan of lining them with lead. A tube is formed of rolled copper, by drawing it through a plate, and the edges are soldered together, so as to form a safe joint, the superfluous solder is dressed off, and the tube again drawn; a piece of lead pipe is then drawn through a plate on a mandrill, of the diameter of the tube required, and placed within the copper pipe; then by passing through it a conical mandrill attached to a rod, the lead pipe is forced against the inner surface of the copper tube, so as to leave them in perfect contact; or sometimes a lead pipe is prepared on a mandrill, of the diameter of the tube required, and a copper pipe, already soldered, drawn over it; they are then passed both together on a mandrill through a draw-plate, so as to bring the two into complete contact. The lead pipe is proof against the action of gas, and the copper pipe, at the same time that it supports and defends it, makes a better appearance.

II. Chemical Science.

§ Chemistry.

1. *Veratrine, a new Vegetable Alcali.*—M. M. Pelletier and Caventou, have been actively engaged in searching amongst those vegetables which possess strong powers over the animal system, for new alcalis or other principles; they have lately succeeded in finding one in the *veratrum sabadilla*, or cevadilla, the *veratrum album*, or white hellebore, and the *colchicum autumnale*, or meadow saffron. It is an alcali, and has been named *Veratrine*.

The substance principally acted upon, was the seed of the cevadilla. Ether separated from them a yellow, greasy, unctuous, acid substance, being a mixture of elaine, stearine, and a peculiar acid. The acid was obtained by distilling the substance, saturating the portion that passed over with barytes, evaporating to dryness which produced a white salt, adding phosphoric acid which caused the appearance of crystals, and distilling at a low heat, when the acid passed over. This acid is crystallizable, soluble in water, fusible and volatile at a low temperature, soluble in ether and alcohol, and forms salts with bases. It has been called the *Cevadic acid*.

The seeds were then acted on by boiling alcohol, which, as it cooled, deposited a little wax. The solution was evaporated down to an extract, re-dissolved in water and again concentrated by evaporation, during which, a portion of colouring matter fell. Acetate of lead was poured into the solution, and an abundant yellow precipitate fell, leaving the fluid nearly colourless. The excess of lead was thrown down by sulphuretted hydrogen, and the filtered liquor concentrated by evaporation, was treated with magnesia and again filtered. The precipitate boiled in alcohol gave a solution which, on evaporation, left a pulverulent matter, extremely bitter, and with decidedly alcaline characters. It was at first yellow, but by solution in alcohol and precipitation by water, was obtained in a fine white powder.

The precipitate by the acetate of lead, on examination, gave

gallic acid, hence it is concluded that the new alcali existed in the seed as a gallate.

Veratrine was found in the other plants before-mentioned. It is white, pulverulent, has no odour, but excites violent sneezing. It is very acrid but not bitter; it produced violent vomitings in very small doses, and according to some experiments, a few grains may cause death. It is very little soluble in cold water, boiling water dissolves about $\frac{1}{1000}$ part, and becomes acrid to the taste. It is very soluble in alcohol, and rather less soluble in ether. It fuses at 50° C=122° Fahrenheit, and then appears like wax; on cooling it becomes an amber-coloured translucid mass: heated more highly it swells, decomposes, and burns; decomposed by oxide of copper, it gives no trace of nitrogen. It acts on test papers like an alcali, and forms uncrystallizable salts by evaporation; these salts appear like a gum. The super-sulphate only seems to present crystals. Strong solutions of these salts are partially decomposed by water; veratrine is thrown down and the solution becomes acid. The sulphate appears composed of

Veratrine	93.723	100
Sulphuric acid	6.227	6.6441

but excess of acid was present, and supposing it an acid salt, and in analogy with those of brucine, the neutral salt will be

Veratrine	100
Sulphuric acid ..	3.322

The muriate contains

Veratrine	95.8606	100
Muriatic acid ..	4.1394	4.3181.

Iodine, by acting on veratrine, produces an hydriodate and an iodate; chlorine produces a muriate and a chlorate.

Ultimately, cevadilla was found to contain elaine, stearine, cevadic acid, wax, acid gallate of veratrine, yellow colouring matter, gum, lignin, and ashes.

White hellebore on analysis, in the same manner gave very nearly the same results. Starch was found in it in addition to the other principles, and the ashes varied a little in the salts they contained. Both contained carbonate of lime, phosphate

of lime, carbonate of potash, silex; the first also, muriate of potash; and the white hellebore sulphate of lime.

The colchicum was examined precisely in the same manner, and gave the same results, with the addition, however, of inuline. The ashes were in such small quantity as to be neglected.—*Annales de Chimie,* iv. p. 69.

Dr. Meissner, also claims to have discovered in cevadilla, a new alcali. He prepares it by making a tincture of the seeds with moderately strong alcohol, evaporating till a resinous matter remains, and rubbing the matter down with water; to the brown liquid obtained by filtration subcarbonate of potash is added, till precipitation ceases; the precipitated matter is then well-washed in water and dried.—*Journal de Pharmacie, Mai,* 1820.

2. *Benzoic Acid.*—M. Vogel has found this acid in the tonquin-bean between the skin and the kernel. It occurs in the form of crystals; these melt, at a moderate heat, into a transparent fluid, which on cooling forms a crystallized mass. At a higher heat it sublimes and forms fine brilliant needles, which are similar in smell to the bean. A concentrated solution of them in alcohol reddens litmus paper, and becomes milky with water. They form a salt with ammonia which precipitates iron of a brown colour. In fine, they are crystallized benzoic acid.

M. Vogel has also found the same substance in the flowers of the *trifolium melilotus officinalis.* He obtained it by digesting the flowers in pure boiling alcohol; on cooling a fatty substance falls, and in two or three days long crystals of benzoic acid. To separate these substances they are digested in boiling water, and the liquid filtered, the acid passes through in solution, and when slightly evaporated yields the benzoic acid in crystals.

3. *Antiseptic Power of the Pyroligneous Acid.*—Results of some experiments, made by Mr. W. Ramsey.—See *Edinburgh Phil. Journal,* iii. p. 21.

A number of herrings were cleaned on the 10th of July, 1819; and without being salted, were immersed for three hours in distilled pyroligneous acid, specific gravity 1012. When

withdrawn they were softened, and not so firm as fish taken out of common pickle. They were hung up in the shade; July and August were hot months, but the herrings had no signs of putrefaction about them, but had a very wholesome smell combined with that of the acid. One being broiled the empyreumatic smell was very strong. The rest, after six months, were in complete preservation.

It was afterwards found that the period of immersion had been too long. If the fish are simply dipped in acid of specific gravity 1012, and dried in the shade, it is sufficient for their preservation; and such herrings, when boiled, are very agreeable, and have not the disagreeable empyreuma of the former.

A number of haddocks were cleaned, split, and slightly sprinkled with salt for six hours; then being drained, they were dipped for about three seconds in pyroligneous acid, and hung in the shade for eight days. On being broiled, they were of an uncommonly fine flavour, delicately white, and equal to the nighly esteemed Finnan haddock.

Herrings were cured in the same way as the haddocks. After being dried in the shade for two months, they were equal in quality and flavour to the best red herrings. The fish retained the shining and fresh appearance they had when taken from the sea.

A piece of fresh beef was dipped for one minute in pyroligneous acid of specific gravity 1012, in July 1819. On March 4, 1820, it was as free from taint as when first immersed. No salt was used in this experiment. A piece of beef was dipped at the same time in pure vinegar, of specific gravity 1009. It was perfectly free from taint on the 18th of November. This experiment indicates antiseptic powers in pure vinegar; some haddocks were cured with it, which remained free from taint, but when cooked had an insipid taste.

When beef is partially salted, and then steeped for a short time in the pyroligneous acid, after being drained and cooked, it has the same flavour as Hamburgh beef. Mr. Ramsey has no doubt, that with proper modifications, the use of the acid may be extended to the preservation of every species of animal food.

In order to ascertain whether the volatile oil in the pyroligneous

acid, or the acid itself, was the agent which prevented putrefaction, Mr. Ramsey dipped haddocks and fresh beef in pure vinegar of specific gravity 1009. When fish were allowed to remain in the vinegar a few minutes, he observed that the muscular fibre was immediately acted on, a partial solution of the fish took place, and the acid became milky. When vinegar of a stronger quality was used, the fish was entirely dissolved, particularly if aided by heat. Both fish and beef which were dipped in vinegar, of specific gravity 1009, and which were afterwards dried in a summer heat, remained for a long time after perfectly free from taint.

Mr. Stodart has repeated some of these experiments, and especially those relating to the haddocks, with perfect success in London.

4. *Purification of Pyroligneous Acid.*—M. Stotze, of Halle, has discovered a method of freeing the vinegar of wood from its impurities, by treatment with sulphuric acid, manganese, and common salt, and subsequent distillation. He obtained a prize from the Royal Society of Gottingen for the discovery.

He has also added to the verifications of the antiseptic powers of pyroligneous acid, and has converted bodies into mummies by continued treatment with it.

5. *Acids of Manganese.*—The results of some experiments made by Dr. G. Forshhammer, on the chamæleon mineral, induce that chemist to believe that there are two acids which may be formed by the combination of manganese and oxygen. These exist in combination in the green and red chamæleon; the first being a compound of manganeseous acid, and the other of manganesic acid. M. M. Chevillot and Edwards were the first who described the property manganese has of forming an acid compound with oxygen, but they considered the red chamæleon as a neutral salt, and the green chamæleon as a sub-salt of the same acid.

Dr. Forshhammer's experiments are published in the *Annals of Philosophy*, 16, p. 130. Some of them have been selected and abridged beneath. A solution of green chamæleon was prepared

by igniting potash with per-oxide of manganese, and dissolving in water. After solution a deut-oxide remained, oxygen having been transferred to that part of the metal dissolved. The green solution soon became red, and deposited deut-oxide of a brown colour.

Solution of pure potash added to the red solution of chamæleon, did not change the colour; but the least drop of alcohol immediately made it green, and if enough were given, a beautiful colour was produced. If too much were added, all colour disappeared, and deut-oxide of manganese remained.

Hence the difference between the green and red chamæleons appears to depend upon the quantity of oxygen combined with the metal. In forming green chamæleon, a part of the per-oxide used is reduced to deut-oxide, and a part raised to the state of an acid, forming the green compound with potash; this green compound gradually changes; the acid in it divides into two parts, one of which is reduced to deut-oxide, yielding up its oxygen to the other which forms an acid more oxygenated than the first, existing in the red compound. Alcohol, when added, deprives this acid of oxygen, converting it first into the acid in the green chamæleon, and then into deut-oxide.

Solution of potash, containing the powder of carbonate of manganese, was poured into a portion of the red solution; the colour became green, and the prot-oxide of the carbonate became deut-oxide. If too much of the carbonate were added, the whole became deut-oxide.

The acid in the green chamæleon, Dr. Forshhammer has called manganeseous acid; that in the red manganesic acid. The manganeseous acid is very easy of decomposition, when combined with potash it forms a sub-manganesite, and whenever the potash is saturated, or its action weakened, the manganeseous acid is decomposed into deut-oxide of manganese, and manganesic acid: hence the changes of the chamæleon. A green solution exposed to the air turns red by the absorption of carbonic acid, which precipitates deut-oxide of manganese. Acids have the same effect, and even water also in great quantity, by weakening the power of the alcali. When the red

colour is changed to green, it is in consequence of the presence of some body absorbing oxygen, as alcohol, prot-oxide of manganese, *&c.*; and Chevreul has shewn that even filtering through paper will have the same effect.

In attempts to get the manganesic acid pure, a solution of the manganesiate of potash was prepared by passing carbonic acid through the green solution, and when filtered, sulphuric acid was added to it; this spontaneously evaporated, gave crystals of sulphate, manganesiate, and bi-sulphate of potash. As in this experiment it was evident that if sulphuric acid at all decomposed the manganesiate, it only did so to form bi-sulphate of potash; it proved that no pure manganese acid could be obtained in this manner. A solution of sub-manganesite of potash was then prepared, and nitrate of lead in solution added to it, which threw down a brown powder, and instantly destroyed the green colour. This brown powder was washed, and then carefully mixed with sulphuric acid, diluted with ten times its weight of water, a portion of the brown powder being preserved to neutralize any excess of acid on the powder. The powder must not be dried before the acid be added to it, and long digestion is necessary for the complete combination of the acid and the lead. In this process the prot-oxide of lead is changed into per-oxide by the manganeseous acid, which itself becomes deut-oxide; and the two combine, forming the brown powder. On adding sulphuric acid the per-oxide of lead is decomposed to form sulphate of lead, and its oxygen combining with part of the deut-oxide of manganese converts it into manganesic acid; this is obtained by decantation, in a separate state.

The manganesic acid thus obtained is in solution 1; it is of a beautiful red colour, and sharp unpleasant taste; it stains the skin and other animal and vegetable substances of a fine brown colour; it destroys the colour of litmus paper rendering it brown by depositing deut-oxide, and would bleach well but that the oxide deposited is of a brown colour itself. When evaporated and heated it decomposes, forming brown oxide of manganese, and giving a smell like that of an excited electrical machine, and the same smell is produced from it by exposure

to the sun. When heated with muriatic acid it is entirely decomposed and reduced to prot-oxide, which combines with the acid.

Alcali is not required for the formation of manganesic acid; hydrated per-oxide of lead, sulphate of manganese, and sulphuric acid, will produce it on mixture, but it is then difficult to free it from sulphuric acid. Also, when chlorine prepared from the per-oxide of manganese is passed into a solution of potash, the chlorine volatilizes a small portion of per-oxide of manganese, and converts it, when acted upon by the potash, into manganesic acid, which combines with the alcali. Again, when chlorine was passed through water containing per-oxide of manganese, and potash added to this saturated water, after separation from the excess of oxide, a small quantity of deut-oxide was precipitated, and the solution became red.

All the oxides of metals seem either to form soluble compounds of a red colour with the manganesic acid, or to decompose it, in which case the oxide added is converted into per-oxide, and the acid into deut-oxide. The brown powder thus obtained by lead is soluble in cold nitric acid with a brown colour, when heated it turns red. Hence the brown powder is a chemical compound of the per-oxide of lead, (acting as an acid,) and the deut-oxide of manganese, for neither of these bodies alone are soluble in nitric acid: when heated to the temperature of boiling water, the oxygen of the per-oxide goes to the manganese, and converts it into manganesic acid.

By igniting nitrate of barytes with oxide of manganese, and washing the green powder thus obtained with boiling water, a manganesite of barytes was obtained. It has a beautiful emerald green colour, and when dry, is very little altered by the air.

The manganeseous acid was analyzed by adding to a certain quantity of the green chamæleon, nitrate of lead; this threw down the brown powder, which contained both the manganese and the oxygen of the manganeseous acid, and prot-oxide of lead. This was distilled with certain precautions with bi-sulphate of potash, and the oxygen evolved estimated, it equalled 4.82 French duodecimal cubic inches, at a temperature of 10° centigrade, equal, according to Biot, to 0.1303057 grammes, (1.7127 gr.). The

salt in the retort was then dissolved by water, the sulphate of lead separated, and the manganese precipitated by carbonate of potash; this heated gave 0,282 grammes, (4,356 gr.) deut-oxide of manganese, these are considered as equal to 0,261 prot-oxide, which were united with 0.1303 of oxygen in the acid.

Dr. Forshhammer then states the composition of 4 oxides of manganese. The sub-oxide 100 metal +20.576 oxygen; the prot-oxide 100 metal +31.29 oxygen; the deut-oxide 100 metal +42,04 oxygen; and the per-oxide 100 metal +62.819 oxygen; the numbers for the oxygen being nearly as 2, 3, 4, and 6.

The manganeseous acid consists of 100 metal, and 96.847, oxygen, which is nearly as the number 9. But Dr. Forshhammer thinks that from the action of water, *&c.*, the green chamæleon already contains a small portion of manganesic acid, and that the manganesite of potash in solution is, when pure, of a blue colour: a colour sometimes obtained in preparations of chamæleon. In this case the proportion of oxygen would be less, and is placed by Dr. Forshhammer at 8.

The manganesic acid was thus analyzed. A solution of green manganesite of potash was made, and converted by carbonic acid into manganesiate, in doing which 136 of deut-oxide fell. The manganesiate was decomposed by alcohol, and gave 214 of deut-oxide. In the preceding analysis ,282 deut-oxide, +,1093 oxygen, gave manganeseous acid; hence ,136+,214=,350 deut-oxide would have ,1354 oxygen in the acid of the green manganesite used above; and this same quantity of oxygen, with the ,214 of deut-oxide, would exist in the red manganesiate after the action of the carbonic acid. The ,214 equals ,1506 manganese, and ,0634 oxygen, which, added to the other quantity of oxygen, gives ,1988. Hence manganesic acid is composed of 100 metal +132 oxygen, which approaches to the number 12; and considering the difficulty of the analyses, and small quantities of the substances, may be considered a near approximation to the truth.

6. *On the Ferro-prussiates.*—M. Berzelius, in a letter to M. Berthollet, says, that in the ferro or ferrugineous prussiates,

the iron is always in the state of protoxide, and that the other base contains twice as much oxygen as the prot-oxide of iron. The acid of these salts is the prussic, composed as M. Gay Lussac has described. Those ferruginous prussiates which effloresce, such as those of potassa, baryta, and lime, lose their water in a vacuum at the temperature of the air. The effloresced salt is no longer a prussiate but a double cyanuret, containing neither oxygen nor hydrogen. When the double cyanuret of iron and potassium, or of iron and barium, are burnt by black oxide of copper, the resulting gas contains three volumes of carbonic acid gas, and two volumes of nitrogen; one volume of carbonic acid gas remains with the base, and forms with it a kind of double salt, composed of carbonate and cuprate of potassa and baryta. The double cyanuret of iron and lead, gives gas in the proportion of two volumes of carbonic acid to one volume of nitrogen. In these combustions, only traces of water are obtained, which are inseparable from the pulverized substances. The ferruginous prussiate of ammonia cannot be reduced to a cyanuret. It is composed of prussiate of prot-oxide of iron and prussiate of ammonia. When distilled, it gives prussiate of ammonia, and a little water, formed by the conversion of the prussiate of iron to cyanuret; the cyanuret then becomes decomposed, and gives nitrogen gas, leaving a carburet of iron composed of four atoms of carbon and one of iron. When this carburet is heated red, it takes fire, and appears to burn as if in oxygen gas, though it is surrounded by nitrogen, and suffers no alteration. The incandescence is analogous to that exhibited by oxide of chrome, oxide of iron, zirconia, *&c.*, when heated red. The same phænomena may be remarked in the distillation of nearly all the ferruginous metallic prussiates, but with none of them is it so brilliant as with the ferro-prussiate of ammonia. Nearly all the ferruginous prussiates dissolve in concentrated sulphuric acid without decomposition. On attracting water from the air, the acid frequently deposits crystals of a combination of sulphuric acid with the prussiate an acid salt with two bases and two acids. M. Berzelius

thought at first, that these salts were formed of cyanurets and sulphuric acid, but as the acid prussiate of the prot-oxide of iron (ferro-prussic acid of Porret,) produces the same phænomenon, it appeared evident that the bases were oxidated, and that the cyanuret was combined with hydrogen. These results make part of a long Mémoire which will appear in the *Mémoires de l'Académie.—Annales de Chim.* XIV. p. 190.

7. *Preparation of Phosphorus.*—M. Julien Javal, in preparing phosphorus lately, observed, that failure took place to a certain extent, when phosphoric acid was used, in consequence of the volatility of this substance at high temperatures. On making the phosphoric acid into bi-phosphate of lime, the process went on well again. As a practical result from his experiments, he advises that on adding the sulphuric acid to the burnt bones in the usual way, only two of the former should be put to five of the latter, in which case a proper bi-phosphate of lime will be obtained. If, by any accident, the prepared bi-phosphate should contain an excess of acid, or rather free acid, then he finds it necessary to cover over the mixture of it and charcoal, when in the retort, with a stratum of charcoal alone, and to get this part of the retort hot before the lower. With these precautions the phosphoric acid which rises is decomposed in passing through the hot charcoal, but otherwise it will be condensed, unacted on.

8. *Metallic Vegetations.*—" M. Goldsmith places a few filings of copper and of iron on a glass plate, at a certain distance one from the other. He then drops a little nitrate of silver on each parcel; the silver soon begins to precipitate, whilst the iron and copper oxidize, and become coloured; then, by a small wooden point, the ramifications are arranged at will, whilst the flame of a taper being placed under the plate, increases the evaporation, facilitates the re-action of the substances, blackens the lower side of the plate, and thus forms as it were a design."—*Annales de Chim.* 14. p. 84.

9. *Muriate of Potash in Rock Salt.*—In consequence of

Dr. Wollaston's discovery of the existence of muriate of potash in sea-water, Dr. Vogel has been induced to search for it in common salt, either from salt springs, or from its native beds. Salt from Hallein and from Berchtesgaden, and the brine from Rosenheim, all yielded a precipitate with the solution of platinum. The simple solution will in no case do this, but when evaporated, until much of the salt has fallen down, then a precipitate may be produced. In testing sea-water for potash, it is also necessary to evaporate till almost all the salt has fallen down, and then no difficulty occurs in detecting the potash by muriate of platinum.

10. *Iodine in Marine Animals.*—M. Chevreul, whilst engaged in some experiments in animal chemistry, discovered the presence of iodine in the bones of the head of the crab, and of the large lobster, (homard,) but could find none in those of the common lobster.

11. *Fulminating Mercury.*—Between 100 and 150 grains of fulminating mercury, on a piece of paper, were lying on a wooden waiter an inch and a half thick, and covered by a glass jar, abundance of glass apparatus lying about. A small portion of the same powder was fired at a few feet distance by a hot coal, and burnt without explosion. By some unknown means, that under the jar *exploded*; it slightly raised the jar without breaking it, but the jar broke in falling, and it disturbed none of the apparatus around. The wood was perforated by a hole as large as the hand.

12. *Test for Copper.*—M. Pagenstecher of Berne has described a very sensible test for the presence of copper. The tests already possessed by chemists for this metal are very delicate, and not few; but still every addition to this branch of chemical knowledge is important. He says "if we drop into a newly-prepared tincture of guaiacum wood, a concentrated solution of a salt of copper, the mixture instantly assumes a blue colour. This effect does not take place when the solution is very weak, as when there is not above half a grain of the

salt to an ounce of water, but then by the addition of a few drops of prussic acid, the blue colour is immediately developed of great purity and intensity. This colour is not permanent, but soon passes to a green, and, at length, totally disappears. In want of prussic acid, distilled laurel water, or that of plum or black-cherry kernels, may be employed. This re-action succeeds, when the proportion of salt to the fluid is not more than a $\frac{1}{45000}$: in this proportion no other test, whether the prussiates of potash, soda, or ammonia, will develope the least indication of the presence of copper."

In using tincture of guaiacum, as a test for copper, care must be taken that no other bodies are present which turn it blue. *Annales Générales des Sciences, &c.*

13. *Process for procuring pure Zirconia.*—Powder the zircons very fine, mix them with two parts of pure potash, and heat them red hot in a silver crucible for an hour. Treat the substance obtained with distilled water, pour it on a filter, and wash the insoluble part well; it will be a compound of zirconia, silex, potash and oxide of iron. Dissolve it in muriatic acid, and evaporate to dryness, to separate the silex. Re-dissolve the muriates of zirconia and iron in water; and to separate the zirconia which adheres to the silex, wash it with weak muriatic acid, and add it to the solution. Filter the fluid, and precipitate the zirconia and iron by pure ammonia; wash the precipitates well, and then treat the hydrates with oxalic acid, boiling them well together, that the acid may act on the iron, retaining it in solution whilst an insoluble oxalate of zirconia is formed. It is then to be filtered, and the oxalate washed, until no iron can be detected in the water that passes. The earthy oxalate is when dry of an opaline colour; after being well washed, it is to be decomposed by heat in a platinum crucible.

Thus obtained, the zirconia is perfectly pure, but is not affected by acids. It must be re-acted on by potash as before, and then washed until the alcali is removed. Afterwards dissolve it in muriatic acid, and precipitate by ammonia. The hydrate thrown down, when well washed, is perfectly pure, and easily soluble in acids.

This process belongs to M. M. Dubois and Silveira. See *Annales de Chim.* XIV. p. 110.

14. *On Artificial Gems.*—M. Douault-Wieland, in an experimental memoir on the preparation of artificial coloured stones, has given the following directions and proportions, as better than those before known.

The base of all artificial stones is the *strass (paste)*, which he called *fondant*, when uniting it to metallic oxides to form the imitations. When worked alone it imitates brilliant and rose diamonds.

The paste is composed of silex, potash, borax, oxide of lead, and sometimes arsenic. The silex should be perfectly pure; if obtained from rock crystal that is the case; if obtained from sand, though of the whitest kind, it ought first to be washed with muriatic acid, and then with water. The crystal, sand, or flint, should be heated red hot, quenched in water, dried, powdered fine, and sifted. The potash should not be mixed with other salt; it ought to be the finest pearlash, or else pure potash, by alcohol. The borax of the markets gives a brown glass; the crystallized boracic acid, from the borax of Tuscany, should be preferred. The oxide of lead should be perfectly pure; if it contains an atom of tin, the glass will be milky. Red lead is preferable to the best litharge, or even to the ceruse of Clichy. It should be analyzed before being used. The arsenic should also be pure.

Hessian crucibles are better than those of porcelain, for though they sometimes colour the matter more, they do not break or run so soon. Either a potter's or a porcelain furnace, may be used, and the fusion should be continued 24 hours; the more tranquil and continued it is, the denser the paste, and the greater its beauty. The four following receipts have given good paste:

No. I.

	Grains.		Grains.
Rock crystal....	4056	Borax	276
Minium.....	6300	Arsenic.....	12
Pure potash	2154		

No. II.

	Grains.		Grains.
Sand	3600	Borax	360
Ceruse of Clichy	8508	Arsenic	12
Potash	1260		

No. III.		No. IV.	
Rock crystal	3456	Rock crystal	3600
Minium	5328	Ceruse of Clichy	8508
Potash	1944	Potash	1260
Borax	216	Borax	360
Arsenic	6		

TOPAZ.

Very white paste	1008
Glass of antimony	43
Cassius purple	1

Or,

Paste	3456
Oxide of iron, called Saffron of Mars	36

RUBY.

M. Douault-Wieland succeeded in obtaining excellent imitations of rubies, by acting on the topaz matter. It often happened that the mixture for topazes gave only an opaque mass, translucent at the edges, and in thin plates of a red colour. One part of this substance being mixed with 8 parts of paste, and fused for 30 hours, gave a fine yellowish crystal like paste, and fragments of this fused before the blow-pipe, gave the finest possible imitation of rubies. The result was always the same.

The following are proportions also for rubies :

Paste	2880
Oxide of manganese	72

EMERALD.

Paste	4608
Green oxide of pure copper	42
Oxide of chrome	2

SAPPHIRE.

Paste	4608
Oxide of cobalt	68

This mixture should be carefully luted in a Hessian crucible, and remain 30 hours in the fire.

AMETHYST.

Paste	4608
Oxide of manganese	36
Oxide of cobalt	24
Purple of Cassius	1

BERYL, OR AQUA MARINA.

Paste	3456
Glass of antimony	24
Oxide of cobalt	1½

SYRIAN GARNET, OR ANCIENT CARBUNCLE.

Paste	512
Glass of antimony	256
Cassius purple	2
Oxide of manganese	2

In all these mixtures, the substances should be mixed by sifting, fused very carefully, and cooled very slowly, being left on the fire from 24 to 30 hours.

M. Lançon has also made many experiments on the same subject. A few of his proportions are as follows:

PASTE.

Litharge	100
White sand	75
White tartar, or potash	10

EMERALD.

Paste	9216
Acetate of copper	72
Per-oxide of iron, or saffron of Mars	1.5

AMETHYST.

Paste	9216
Oxide of manganese	from 15 to 24
Oxide of cobalt	1

15. *Spontaneous Combustion of Cloth.*—About twenty-five pieces of cloth, each of which contained nearly thirty ells,

were deposited upon wooden planks in a cellar at Lyons, on the 8th of July, 1815, in order to conceal them from the armies which then over-ran France. In the manufacture of the cloth, 25lbs. of oil were used for a quintal of wool, and the cloth was quite greasy, each piece weighing from 80lbs. to 90lbs. The cellar had an opening to the north, which was carefully shut up with dung, and the door was concealed by bundles of vine props, which freely admitted the air. On the morning of the 4th of August, an intolerable smell was felt, and the person who entered the cellar was surrounded with a thick smoke which he could not support. A short time afterwards he re-entered with precaution, holding a stable lantern in his hand, and he was astonished to perceive a shapeless, glutinous mass, apparently in a state of putrefaction. He then removed the dung from the opening, and as soon as a circulation of air was established, the cloth took fire. In another corner of the cellar lay a heap of stuffs which had been ungreased and prepared for the fuller, but they had suffered no change. The above particulars were carefully established by M. Cochard. Comte rendu des Travaux de la Soc. Roy. d'Agriculture, &c. de Lyons pour, 1817.—*Edinburgh Journal.*

16. *Evaporation of Spirits.*—Mr. Ritchie, of Perth, has published a curious statement respecting the evaporation of mixtures of alcohol and water. He commences by the following theorem,—" The degrees of cold, induced by the evaporation of spirits of different degrees of strength, are proportional to the strength of those spirits, reckoning from the degree of cold induced by the evaporation of water." This is established by the following experiments:—

" Having made three very delicate hygrometers, according to Leslie's construction, I moistened the bulb of one of them with strong whisky, the bulb of another with a mixture of equal quantities of the same spirits and water, and the bulb of the third with water. I watched the descent of the fluids in the stem till each had gained its maximum of cold, and marked the cold induced by the water 40, by the dilute spirits

64, and by the strong spirits 88. Now the difference between 40 and 64, is 24, and between 40 and 88, is 48. Hence the following proportion 24 : 48 : : strength of the dilute : strength of the strong spirits. This I have tried with different proportions of spirits and water, in different states of the atmosphere, and found the same property uniformly obtain. The experiment requires to be performed with great delicacy and care, as the spirits soon acquire their maximum, after which the fluid in the stem begins to ascend."—*Annals of Philosophy*, xvi. p. 215.

17. *Electrical Experiment.*—The following experiment is described by Professor Moll. Place a thin piece of tin foil vertically between two horizontal and insulated rods of brass, each terminated by a knob, and distant from each other between one and two inches, then pass from one to the other a strong charge of a large electrical battering. The plate of tin will be found pierced by two holes, with their burs in opposite directions. That the experiment may succeed, the tin foil should be thin, and the charge strong, otherwise only two impressions will be seen on the plate.

18. *Improvement in Dyeing.*—Cloths which are dyed in the piece, frequently present at the edges a line corresponding to the middle of the piece of cloth, more lightly dyed than the surface. This sometimes produces a disagreeable effect. From the Count de la Boulaye-Marsillac's experiments, it appears to be occasioned by the water which remains in the wool before immersion in the dye stuff, from the previous wetting process. This water either excludes or dilutes the dye, and renders it less effectual within the cloth than at the surface. To obviate this the Count makes the cloth pass through rollers within and at the bottom of the dye-vat, by which the mere water is very completely expelled, and the dye takes its place. In passing the cloths backwards and forwards in the dye-vat, they are made each time to go through the rollers.

Scarlet cloths thus dyed are so intense in colour as to appear less bright than common scarlet, but this is obviated by adding turmeric or fustic to the bath.

19. *Test for Baryta and Strontia.*—Baryta and strontia may readily be distinguished from each other by the following process:—Make a solution of the earth, whichever it may be, either by nitric, muriatic, or some other acid, which will form a soluble salt with it; add solution of sulphate of soda in excess, filter and then test the clear fluid by subcarbonate of potash; if any precipitate falls the earth was strontia, if the fluid remains clear it was baryta.

20. *On Meteoric Stones, by M. Laugier.*—Among the substances which enter into the composition of aërolites, three may be considered as characteristic: sulphur, nickel, and chrome, the silex, iron, magnesia, and manganese, being common to other lapideous mixtures. Of these three substances the sulphur is least important, because of common occurrence in pyrites: the remarkable circumstance attending it is its constant union with nickel. The nickel has had most importance attached to it, partly because it occurs in greater quantity than the chromium, and partly because found in those masses of iron called meteoric.

The chrome has been considered as of least consequence, because of the smallness of its quantity, and because it has been said to be wanting in some aërolites, as in that from Stannern, in Moravia. But if it be shewn that an aërolite contains *no* nickel, whilst the stone from Moravia does contain chrome, will it not be proper to consider chromium as the most important character of these peculiar bodies?

M. Laugier has drawn this consequence from a comparative examination of the stone which fell recently at Jonzac, and that of Moravia, specimens of which were given him by M. M. Haüy and Brongniart.

The stone from Jonzac fell on the 13th of June, 1819, that from Moravia on the 22d of May, 1808. Both present the physical characters of aërolites, differing only in one of them. Meteoric stones are generally covered by a compact uniform dull black crust of a certain thickness; the crust of these two stones, on the contrary, is light grey, shining and glassy.

The mode of analysis was by successive treatment with alcali and acid. The stone from Jouzac, thus examined, gave no nickel, and when other essays were made to discover this metal, they all failed. Hence it is concluded that there was none in the stone, and from the facility of finding the metal when present, there can be no doubt that the conclusion is well founded.

It is composed of	Oxide of Iron	36
	Silex	46
	Alumina	6
	Lime	7.5
	Oxide of Manganese ..	2.8
	Magnesia	1.6
	Sulphur	1.5
	Chrome	1
		102.4

the excess resulting from oxidation of the metals.

All the meteoric stones which Mr. Laugier examined, were found to contain chromium. He first found it in the stone from Verona, which fell in 1663, and it was not long before its existence was ascertained in the stone from Moravia, which contains a $\frac{1}{100}$ part. It was found too in the native iron of Siberia.

In testing for the chrome M. Laugier observes, that " if muriatic acid be immediately added to the alcaline solution, there remains no symptoms of the chrome; but that, if before adding the acid, the alcaline solution be boiled with access of air, and long enough to precipitate all the oxides of maganese and iron, the yellow colour of chromate of potash will remain, however small its quantity, and nothing is required afterwards but to saturate the alcali by nitric acid, and to add a solution of nitrate of mercury."

It results from M. Laugier's experiments, that among the meteoric stones known, one contains *no* nickel, whilst all contain chrome; and hence he concludes that of the two, chrome is the most important character.—*Mémoires du Muséum*, vi. p. 233.

III. Natural History.

§ Medicine, &c.

1. *Remedy for Bronchocele.*—The *Bibliothèque Universelle*, for July 1820, contains a paper by Dr. Coindet, on a new remedy for the goitre, which, from his experience, appears to be very effectual. From the circumstance that burnt sponge formed the basis of all successful remedies as yet used for this disease, Dr. Coindet considered that iodine might be the particular substance that was useful; and, in consequence, applied it in different forms. One preparation was a solution of forty-eight grains of hydriodate of potassa, equivalent to thirty-six grains of iodine, in an ounce of water.

Sometimes iodine is dissolved in this solution, to increase the force of the remedy in very difficult cases.

Another preparation, called tincture of iodine, was made by dissolving forty-eight grains of iodine in an ounce of alcohol of 35 (S. G. 842).

The quantity for an adult was ten drops of one of these preparations, in half a glass of syrup of capillaire and water, taken early in the morning, fasting; a second dose was given at ten o'clock; and a third in the evening, or at bed-time. At the end of the first week, fifteen drops were given in place of ten, three times a day; and, in a few days after, when the effect seemed evident on the tumours, it was increased to twenty drops. This quantity has rarely been increased, and was generally sufficient to dissipate the larges goitrest.

After about eight days' treatment the skin becomes less tense, and apparently thicker. The tumour softens, as becomes evident to the touch; the goitreous tumours, if there are several, become more distinct and separate; they soften and gradually dissolve. In many cases the nucleus, or part which is organically deranged, becomes harder, diminished in size, and isolated; sometimes they become moveable; a circumstance of great advantage in those cases where an operation is necessary.

In some cases the cellular structure, which pervaded the tu-

mour, remains swelled, and feels to the touch like an empty cyst. Frequently also the goitre disappears only partially, but to an extent sufficient to be neither inconvenient nor a deformity. In many cases it is dissolved, destroyed, and dissipated in from six to ten weeks, so as to leave no traces of its previous existence.

That the effect of the remedy might be obtained free from any other effect, all local applications were avoided, which either by compression, or from the saline substances they contained, could produce any interfering result.

2. *Antidote for Vegetable Poisons.*—M. Drapiez has ascertained, by numerous experiments, that the fruit of the *feuillea cordifolia* is a powerful antidote against vegetable poisons. This opinion has long been entertained by naturalists, but it has not before been verified by experiments made in any part of Europe. M. Drapiez poisoned dogs with the rhus toxicodendron, hemlock and nux vomica; all those that were left to the effects of the poison died, but those to whom the fruit of the *feuillea cordifolia* was administered recovered completely, after a short illness. To see whether this antidote would act in the same way applied externally to wounds, into which vegetable poisons had been introduced, he took two arrows, which had been dipped in the juice of manchenille, and slightly wounded with them two young cats; to one of these he applied a poultice, composed of the fruit of the *feuillea cordifolia*, while the other was left without any application. The former suffered no inconvenience except from the wound, which speedily healed; while the other, in a short time, fell into convulsions, and died.

It would appear from these experiments, that the opinion entertained of the virtues of this fruit, in the countries where it is produced, is well founded. It would deserve in consequence to be introduced into our *Pharmacopæias* as an important medicine; but it is necessary to know, that it loses its virtues if kept longer than two years after it is gathered.—*Medical Journal.*

3. *Vegetable Antidotes to Poison.*—Dr. Chisholm, in a paper read to the Society at Geneva, states, that the juice of the sugar-cane is the best antidote known for arsenic. It has been tried upon various animals in the West Indies with complete success, and always succeeds. Its power in the island of Nevis is generally known.

Dr. Chisholm also mentions the singular powers of a plant, well known to the Indians, as a remedy for the ophthalmia; it is called *akouserounie* and *warannie* by them, and *eye-root* by the white people. It grows in *la Guyane*, in the neighbourhood of Demerara, in a sandy soil, and is a species of bignonia, which Dr. C. has since called ophthalmica. An Indian prepares the remedy from the root of the plants, by first stripping off the brown epidermis, and then separating a fibrous pulpy part immediately beneath; this he presses on cotton so as to collect the juice, and then by means of a paper funnel conveys a drop or two of it into the eye. This is repeated once a day for three or four days, in which time the cure is generally completed. Dr. Chisholm had occasion in his own practice to apply this remedy in three cases; and having only the dry root, he rasped off the outside, and then made a strong infusion of the part beneath. Six drops of this infusion were introduced into each eye once a day, and in six days' treatment they were perfectly cured, though they had suffered for many weeks previously.

4. *On the Poison of the Viper.*—M. Configliacchi has been engaged on experiments with this poison. It was obtained by pressing the vesicles behind the canine teeth into a watch-glass, and applied by means of a needle.

He established, in the most positive manner, that this poison had no effect, except when introduced into the blood-vessels; flour-pills were dipped into the poison, and swallowed by birds without producing any injury to them.

One object was to ascertain the effect of Voltaic electricity on birds poisoned by this venom. Some birds dead, but still warm, were subjected, with others killed, either by breaking the neck, suffocation, or decapitation, to the powers of a pile of

24 pair of plates. excited by a solution of sulphate of alumine, one pole being connected with the spinal marrow, and the other with a muscle of the knee. The result was, that the irritability of the muscles was considerably diminished in those animals killed by the poison, its duration not being more than one-fourth of that of the other animals, or even one-sixth of that of the decapitated birds. It was also so weak, that four times the quantity of plates did not produce an equal effect in them.

Another result was, that, when poisoned birds not yet dead, were submitted to voltaic action, their death was hastened. The mean of three experiments gave six minutes as the difference between the death of poisoned birds electrified, and not electrified.

It was also ascertained that birds poisoned by prussic acid, more or less strong, as laurel-water, concentrated to various degrees, gave the same results, except that the duration either of the pain or of the irritability of the muscles was much shorter than with the viper poison.

5. *Cure for the Hydrophobia.*—The number of remedies for this dreadful malady, of which accounts have lately been given, is rather remarkable. Dr. Lyman Spalding, one of the most eminent physicians of New York, announces, in a small pamphlet, that for above these 50 years the *Scutellaria Lateriflora* has proved to be an infallible means for the prevention and cure of the hydrophobia, after the bite of mad animals. It is better applied as a dry powder than fresh. According to the testimonies of several American physicians, this plant, not yet received as a remedy in any European *Materia Medica*, afforded perfect relief in above a thousand cases, as well in the human species as in the brute creation (dogs, swine, and oxen.) The first discoverer of the remedy is not known; Drs. Derveer father and son,) first brought it into general use.—*Phil Mag.* lvi. p. 151.

6. *Substitute for Peruvian Bark.*—M. Ré, professor of Materia Medica at the Veterinary School at Turin, has announced that the *Lycopus Europæus* of Linnæus is a complete succedaneum

for Peruvian bark. It is called by the peasants of Piedmont, where it is found in great abundance in marshy places, the Herb of China.

7. *Plantain-Root a Febrifuge.—Switzerland.*—Dr. Perrin has lately read to the Society of Natural Sciences, of which he is a member, observations made on the febrifugal virtues of the roots of the plantain *(plantago major, minor, et latifolia, Linn.)* He is of opinion that it may be employed with advantage in intermittents. The question may easily be decided, as the plant is common every where.

8. *Medical Prize Question.*—A satisfactory answer not having been given to the question, " Can the existence of Idiopathic fever be doubted," proposed last year by the Société de Médicine of Paris, it is re-proposed, the greatest latitude being given to candidates, in the choice and developement of their opinions.

The prize will be a gold medal, of 300 francs value; but, as a further stimulus, the society will, if there be opportunity, award gold medals, of 100 francs value, to the mémoires which may most nearly obtain the prize, and silver medals of emulation.

The concourse will close on the 30th September, 1821. The mémoires, written in French or Latin, to be sent, carriage-free, before then, to the Secrétaire Générale de la Societé de Médicine, Rue St. Avoie, No. 39.

9. *Prize Question.*—The Academy of Sciences of Paris, propose the following:—" To follow the developement of the triton, or aquatic salamander, in its different degrees from the egg to the perfect animal, and to describe the change which it undergoes interiorly, principally in respect to its osteology and the distribution of its vessels."

The Prize, of the value of 300 francs, will be adjudged in the public sitting of 1822. The utmost term for the transmission of Mémoires is January 1, 1822.

10. *Prize Question.*—The Society of Sciences at Copenhagen, have proposed the following:—

"Quibus naturæ legibus regitur primaria evolutio corporum animalium, et formam sive regularum, normalem, sive abnormem adsciscant?"

The author of the best answer to this question will receive a gold medal, of the value of fifty ducats. The Memoirs should be addressed, with the usual forms, before the end of December 1820, to the Secretary of the Society, Professor Oersted at Copenhagen.

§ MINERALOGY, GEOLOGY, METEOROLOGY, *&c.*

1. *Chromate of Iron in Shetland.*—It has been recently asserted that the chromate of iron was discovered in Shetland by Dr. Hibbert. Without wishing to undervalue Dr. Hibbert's labours, we must, in justice to Dr. Traill, remark that he pointed out the existence of this mineral in Unst, many years ago. It is true that he calls it magnetic iron ore, but the existence of a chromate was then unknown; nor indeed, we believe, had chrome been discovered at the time Dr. Traill wrote his account. The substance, as we understand, is so abundant that the ground is strewed with it, so that it could not be overlooked.

2. *Boracic Acid.*—Dr. Pleischl, of Prague, has given the following as the composition of crystalline hydrated boracic acid:—

Dry acid.....	54
Water.....	45

During the experiments made to ascertain these proportions, Dr. Pleischl endeavoured also to ascertain the action of dry boracic acid on dry chloride of barium. The results coincided with those of Gay-Lussac and Thenard; no decomposition took place nor was any new compound found.

3. *Fluoric Acid in Mica.*—M. Rose, of Berlin, at present working in the laboratory of M. Berzelius, has ascertained that

all the kinds of mica, contain fluoric acid. Two species from Sweden contained a considerable quantity.

4. *Tremolite.*—M. C. G. Retzius analyzed the tremolite, and found it to contain—

Silex	54.26
Lime	23.16
Magnesia	7.56
Carbonate of Lime ..	13.86
Loss	1.16
	100.

5. *Volcanoes of Tartary.*—M. Abel Remusat, in a letter to M. Louis Cordier, relating to the origin of the sal ammoniac, obtained by the Calmucs, and by them distributed through Asia, quotes the following passage from the Japanese edition of the Chinese Encyclopædia, in the king's library, which not only describes the source of this salt, but also two active volcanoes in the interior of Tartary.

"The salt, named (in Chinese) *nao-cha*, and also salt of Tartary and volatile salt, is obtained from two volcanic mountains in Central Tartary. One is the volcano of Tourfan*, which has given to this town (or rather to a town three leagues to the east of Tourfan,) the name of Ho-Tcheou, or town of fire. The other is the white mountain in the country of Bisch-Balikh†. These two mountains continually emit flame and smoke. There are cavities in them in which a greenish liquid collects, which, when exposed to the air, changes into a salt, which is the *nao-cha;* the people of the country collect it for the preparation of leather.

A column of smoke may be continually seen coming from the Tourfan, which, in the night, is replaced by a flame similar to that of a flambeau. Birds, and other animals, illuminated by it, appear of a red colour. This mountain is called the *Hill of*

* Lat. 43°. 30′., long. 87°. 11′. according to P. Gaubil.

† A town situated on the river Ili, to the S. W. of the lake of Balgasch which the Chinese name the *hot sea*. The latitude of the lake of Balgasch, is 46°.; long. 76°. 11′. according to P. Gaubil.

Fire. Sabots, or wooden shoes, are worn by those who collect the *nao-cha*, for shoes of leather would be soon burnt.

The people of the neighbourhood also collect the mother-waters, which they boil in vessels, and obtain from them the sal ammoniac in lumps or loaves, like those of common salt. The whitish *nao-cha* is considered the best. The nature of the salt is very penetrating. It is suspended in a stove to make it very dry, and ginger is added to it to preserve it. Exposed to cold, or to moisture, it deliquesces and is lost."

M. Remusat adds in his observations, that it is a curious fact, and very little known, that there are two volcanoes actually in combustion in the central regions of Asia, 400 leagues from the Caspian, which is the nearest sea to them.—*Annales des Mines*, v. p. 135.

6. *Temperature of Lakes.*—From observations made by M. De la Bèche, on the lakes of Thun and Zug, in Switzerland, the following temperatures were found to exist at different depths. The lake of Thun is about midway, between a point called the Nase, and the village of Leissingen.

	Fahr.
At a depth of 105 brasses the temperature was	41°5
..... 50.....	41°5
..... 15.....	42°
At surface	60°

The bottom of the lake was sandy, and the water not very transparent; the thermometer and weight disappeared at the depth of 7 or 8 feet.

The observations on the lake of Zug were made about a league from the town, and in the direction of Mount Riggi.

	Fahr.
At a depth of 38 brasses the temperature was	41°
..... 25	41°
..... 15	42°
At surface	58°

The water of this lake was clear, and the lead brought up very small gravel from the bottom.

17. *Organic Remains.*—M. de la Buhe, in a letter to Professor Pictet, says, " I was much surprised to see in this collection (belonging to Professor Meissner, of Berne,) the teeth of a mastodon, and those of other animals of less size, enveloped in the coal of Alpnach (if I do not deceive myself,) near the lake of Zurich. Mr. Meissner informed me that the stratum of coal occurred in banks of sandstone gres. This is a circumstance which ought to draw the attention of the Swiss geologists. The fact is certain. The teeth are black, and appear strongly impregnated with bitumen.

18. *Falling of a Mountain.*—On the 8th of July last, at four o'clock in the morning, a part of the mountain *Sichen-Rethrenberge*, near Moselle, in the circle of Cochereim, ten leagues from Coblentz, fell into the river. A movement almost insensible, but neverless progressive, has been observed for many years of this enormous mass. The damage occasioned by it is almost incalculable ; more than 20 vineyards have disappeared.

A neighbouring mountain, called *der Kessel*, threatens also to fall. Enormous crevices occur in it near the middle, and at the summit, and the lower part descended three feet on the morning of the 8th, with the loosening and falling of many large pieces. It is feared that this mountain falling into the Moselle will stop it up, and cause sad distress.

19. *Earthquake.*—A strong shock of an earthquake was felt at Inspruck, on the 17th of July. It lasted four seconds. It is curious that the shock happened at the very hour of the day on which the people of the place were assembled together in prayer, which, according to a vow made in 1670, was to be made annually, in consequence of a dreadful shock which happened at that time.

10. *Red Snow.*—The red snow has appeared this year much sooner than usual, and, though at two leagues from the convent of St. Bernard, there was no place without snow, except some steep rocks ; yet it was decidedly red at the foot of inclined places, and began to reunite in the channels formed by the

waters. It appears evident that it cannot be attributed to any vegetable powder.—*Tableau des Observation*, &c. *May*, 1820.—*Bib. Universelle.*

11. *Regions of perpetual Snow.*—The following Table is from the termination of a *Mémoire*, by M. Alex. de Humboldt, on the limit of perpetual snow in the Himáláya Mountains and the equatorial regions. See *Annales de Chim.*, XIV. p. 5.

Parts of the world, where the Mountains rise above the Limit of perpetual Snow:

Equator. —*Andes of Quito.* (Africa?)

10° of lat.—Sierra de Merida, Sierra de Santa Marta, (Mont Al Komri?)

20° of lat.—*Plain of Mexico, Mowna Roa* of the Sandwich Isles, High Peru (New Holland?)

30° of lat.—*Himáláya*, Atlas near Morocco, *Etna? Sierra Nevada de Grenade*, Cote de Caramania, Chili, (New Holland?)

Heights of perpetual Snows measured.

Andes of Quito (lat. 1°—1° 30′) 2,460 toises; Volcano of Puracé near Popayan (lat. 2° 18′) 2,420 t.; Tolima (lat. 4° 46′) 2,380 t. (?) Nevados of Mexico (lat. 18° 59′—19° 12′) 2,350 t. No perpetual snows on the peak of Teneriffe (lat. 28° 17′) 1,908 t.; Himáláya, (lat. 30° 40′—31° 4′) southern side, 1,950 t.; northern side 2,605 t. (?) Sierra Nevada of Grenada, the summit not the inferior limit (lat. 37° 10′) 1,780 t.; Etna (lat. 37° 30′) but only spots of snow 1,500 t.; the summit, which also perhaps does not enter the curve of perpetual snow, 1,719 t.; Caucasus (lat. 42°—43°) 1,650 t.; Pyrenees (lat. 42°,5—43°) 1,400 t.; Swiss Alpes (lat. 45¾°—46½°) 1,370 t.; Carpathian Mountains (49° 10′) 1,330 t.; Norway (lat. 61°—62°) 850 t.; (lat. 67°) 600 t.; (lat. 70°) 550 t.; (lat. 71½°, but under the influence of summer fogs, 366 t.

The heights of the places printed in Italics have been measured.

IV. General Literature.

1. *Modern Greek Literature*—M. Koumas, first professor in the great college at Smyrna, and distinguished by his learning among the Greeks, has just published at Vienna the two last volumes of his *Course of Philosophy*. The whole work is a methodical abstract of all the best compositions of the German philosophers. Its object is to instruct the Greeks in modern philosophy, and its circulation is likely to be very considerable.

The printing-office established at Chios has commenced its operations, and is now in full activity. Its first production is an excellent discourse of M. the Professor Bambas, read the year before last, at the opening of the course of the great college of Chios. This work is so elegant in its typography, that it might seem to come from the presses of London or Paris. This office will gradually spread through Greece a number of valuable works that may contribute to the regeneration of this once classical land.

A college on a large scale is about to be founded at Zagori, in the province of Epirus. The voluntary donations for this establishment amount already to 60,000 francs. M. Neophytos Doucas, a learned Greek ecclesiastic himself gave the sum of 10,000 francs.

2. *Philology*.—M. Frederick Adelung, counsellor of state to the Emperor of Russia, has lately published, in 153 pages, *A View of all known Languages and their Dialects*. In this View, we find in all, 987 Asiatic, 587 European, 276 African, and 1,264 American languages and dialects enumerated and classed: a total of 3,064. This remarkable publication is only the introduction to a *Bibliotheca Glottica*, on which this indefatigable philosopher has been long employed.

3. *Ancient Latin Manuscripts*.—Baron Niebuhr, Prussian ambassador to the Holy See, has again discovered and published several ancient MSS. hitherto unknown. They are chiefly

fragments of Cicero's orations, pro M. Fonteio et pro C. Rabirio; a fragment of the 91st book of Livy; two works of Seneca, &c. Baron Niebuhr has dedicated this edition to the Pope, by whose favour he was enabled to discover these literary treasures in the library of the Vatican.

4. *Excavations at Pompeia.*—A public edifice has recently been discovered near the forum of Pompeia, which is supposed to be the Chalcidicum, and an inscription importing that the edifice was built at the expense of the Priestess Eumachia. A few days after the above discovery, a statue of the same priestess was found in perfect preservation. This statue is said to very far surpass in grace, elegance, and grandeur, all the works of art that had previously been dug from the ruins of this town.

5. *Population, &c., of Paris.*—From a work lately published in Paris, it appears, that that city contains 714,000 inhabitants, of which 25,000 are not domiciled. The consumption of bread annually is 113,880,000 kilogrammes (251,336,719lbs.); of oxen, 70,000; of heifers, 9,000; calves, 78,000; sheep, 34,000; swine, 72,000; eggs, 74,000,000; pigeons, 900,000; fowls, 1,200,000; wine, 870,000 hectolitres (22,968,000 gall.)

6. *Population of Sweden.*—According to the last census, taken in 1819, the population of the kingdom of Sweden amounted to 2,543,412 inhabitants. The amount of the registers of what is called the civil state of Stockholm, for the year 1819, has produced a result unfavourable for the population. The births were 2,329, and the deaths 3,238; a diminution has therefore taken place of 909 individuals. Almost one-half of the children are born out of marriage; out of three children one has invariably died. The marriages have been 504, and the divorces 24.

7. *Population of Glasgow.*—An actual survey, to determine the population of Glasgow, was completed in February, 1820. The following is an abstract of the information derived from it:

Population of the ten parishes within the Royalty		75,169
Barony Parish.		
Anderson district	7,113	
St. Vincent St. and Blythswood estate district	7,941	
Port Dundas district	7,598	
Calton and Mile-end district	15,616	
Bridge-town district	13,593	51,861
Gorbal's parish, including Hutcheson-town, Lauries-town and Trades-town		21,768
		148,798

As several thousand persons had left the population district for want of work during the few months which preceded the enumeration, and as some of these persons may be expected to return, the population may be fairly stated at 150,000 persons.

8. *Statistics of America.*—The superficies of the territory of the United States, from the Atlantic to the great ocean, is estimated at 2,257,000 square miles, and the population at 11,000,000. The proportion of whites to blacks has increased as follows, since the year 1790. In that year there were 27 blacks to 100 whites; in 1800, the proportion was 20 to 100; and in 1810, only 19 to 100. The number of emigrants that arrived in the different states in 1794 was about 10,000; in 1817, 22,240, of whom 11,977 were British or Irish. From the British possessions in America, there arrived, in the same year 2,901 individuals.

9. *Carmine.*—M. Von Grotthus says, that carmine may be freed from its yellow shade, by treatment first with ammonia, and then with acetic acid and alcohol.

10. *Death of an Elephant.*—An elephant had been brought to Geneva for exhibition some months ago, and was found to be remarkably obedient and docile. In removing this animal from place to place, it was not confined in a caravan, but passed openly by the streets and roads, attended by three conductors, and no accident had as yet happened in this way; but, on removing it from Geneva, the animal became ungo-

vernable, pursuing its guardians, and endeavouring to do mischief. It returned towards Geneva again, and, by various means, was got into a place of security; and then its proprietor, intimidated by a former accident, resolved to have it put to death. The first intentions were to poison it, and, for this purpose, three ounces of prussic acid were mixed with ten ounces of spirits, and given to it. The animal took the bottle, and drank the liquor; but, after the lapse of some time, did not seem at all affected by it. Three balls were then prepared, each containing one ounce of arsenic, mixed with sugar and honey, and were eaten by the elephant. This poisoning commenced at five o'clock in the morning, and, at the end of an hour, not the slightest effect was produced on the animal. Finding these means ineffectual, orders were given, and the animal shot with a four-pound ball in the head.

After a while, the animal was dissected for the museum, but the muscular parts were given to the people, who took it home as food. Between three and four hundred persons ate of it without any fear from the poison, and without any ill effects except from indigestion.

This elephant was from Bengal, was about nine feet high, and ten years of age.

11. *On the Columns of the Athenian Temples, by Thomas Allason, Esq.*

To the EDITOR *of the* JOURNAL *of* SCIENCE *and the* ARTS.

The following passage is extracted from the *Travels* recently published by the Rev. Thomas Hughes: "Amongst the many observations made by Mr. Cockerell, upon the architecture of the Parthenon *I remember one*, which seemed very delicate and curious; it related to the entasis, or swelling of its beautiful and finely-proportioned columns. With a great deal of difficulty he measured them, and found by a straight line stretched from the capital to the base, that this swell, at about one-third of the height, equalled one inch; that in the Temple of Jupiter at Ægina, half an inch, which was in proportion to the other; so that he had no doubt but that there was a general rule

on this point with the ancient architects: this protuberance is so delicate, that it must be ascertained by measurement; the eye alone cannot perceive it: the fact had escaped Stuart, and our other most accurate observers."

From this relation it might be too readily concluded that Mr. Cockerell made the discovery therein mentioned, whereas the fact is otherwise. It was myself who first noticed this peculiarity, during an extensive tour through the Morea, with the Messrs. Spencer Stanhopes, in the year 1814, when, having formed my opinion, by a careful examination of the magnificent remains of the ancient structures at Athens*, I communicated the results to Messrs. Cockerell, Fauvel, Baron Haller, Lusieri, and Tupper; the two former gentlemen, however, constantly opposed my ideas upon the subject. It was, indeed, my actual intention to have ascertained the nature and extent of the *entasis* of the columns of all the temples and other ancient buildings at Athens; various unforeseen circumstances, however, deferred its execution, which was finally rendered impracticable by a severe illness, that obliged me to take a very precipitate departure from the Athenian territory, after a residence of about five months. It was thus arranged, that Baron Haller and Mr. Cockerell should themselves measure, and make the necessary experiments upon the columns of the Parthenon, the Temple of Theseus, *&c.*, and transmit the results to Mr. Stanhope and myself.

We both felt so desirous respecting this inquiry that, on our arrival at Naples, we wrote to Mr. Cockerell, reminding him of the obligation he had taken upon himself; it was, however, more than a year afterwards that I received, through Mr. R. Smirke, an admeasurement of the columns of the Parthenon, confirming my opinions in every particular. I shall also here beg to observe, that my remarks respecting the *entasis* of the Greek columns was noticed in a report read by Mons. Barbie du Boccage to the Institute, several months prior to my receiving Mr. Cockerell's communication.

I shall now take the liberty to inquire of the Rev. Thomas

* See note to preface of my work on the Antiquities of Pola.

Hughes, why he relates this circumstance from memory, rather than from the authority of his journal? I may, perhaps, venture to assign the genuine reason. The transactions alluded to, occurred in 1814, twelve months after this gentleman had left Athens; and therefore it was not possible for his journal to contain one tittle of the matter. Why also has the Reverend Gentleman stated, that "this protuberance is so delicate, that it must be ascertained by measurement, the eye alone cannot perceive it?" The reason is obvious, Mr. Cockerell well knew that I had no other means of satisfying myself respecting the *entasis*, than from the most attentive ocular observation. This opinion, therefore, is hazarded, in order to support his pretensions to the discovery, in opposition to mine, as I had not the opportunity to pursue the satisfactory means which he was enabled subsequently to apply.

In requesting your insertion of the foregoing statement, I am not so anxious to claim the merits of a discovery, although unnoticed by so many distinguished travellers, as to direct the attention of professional men and others, to so important a feature, upon which principally depends the effect and beauty of Grecian architecture.

I am, your obedient humble servant,

THOMAS ALLASON.

27, *South Molton-street, August* 21, 1820.

12. *Geological Maps and Works.*—The Geological Map of England, published by Mr. Smith, and the more recent and accurate one of Mr. Greenough, have proved of great use and value to the geological traveller; a set of small, but accurate, county maps, coloured upon the same plan, would prove, perhaps, a more valuable acquisition, and we trust that such a desideratum will soon be carried into effect.

We are glad to understand that a geological map of Scotland will shortly be published by Dr. Mac Culloch, whose accurate and extensive geological investigations in that part of the kingdom, peculiarly fit him for the task.

We are also informed that Dr. Mac Culloch has nearly com-

pleted an elementary work on geology, and that he is engaged in a description of Shetland, upon the same plan as that of the Western Isles of Scotland, which he published last year.

13. *Mineralogy of Scotland.*—Prehnite has hitherto only been found in Scotland in trap; it is thus abundant near Glasgow and Dumbarton; it also occurs at Edinburgh, in Fife, and in the isles of Mull, Rasay, Arran, and Sky.

This mineral has lately been found in the north of Scotland, in gneiss; it occurs in the same botryoidal form as in the Kilpatrick hills. It has also been found in the same rock, imperfectly crystallized, in the island of Guernsey.

Hollow spar has been lately discovered, for the first time, in Scotland; it occurs in clayslate, in the vicinity of Balahulish.

Cyanite, which has hitherto only been found in Shetland, and at Boharm, in Banffshire, exists also in Cairnlia, one of the summits of Ben-y-Gloe, and in Glen-Tilt; it is embedded in quartz.

Staurolite has lately been, for the first time, found in the north of Scotland, in mica-slate; the crystals are perfect, and occur both simple and crossed; they are of a large size, but differ in composition from those of Brittany and Switzerland; their colour is dark lead-gray; and their fracture not unlike that of claystone.

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14. *St. George's Medical and Chemical School.*—The Courses will commence on Tuesday, October the 5th.

1.—On the Laws of the Animal Economy, and the Practice of Physic, with Pathological Demonstrations; at nine in the morning, by George Pearson, M.D. F.R.S., senior physician to St. George's Hospital, *&c. &c.*

2.—On Chemistry, in which Medical Jurisprudence will be introduced, by W. T. Brande, Sec. R. S., Professor of Chemistry at the Royal Institution, *&c.*

3.—On Therapeutics, with Materia Medica; at eight in the morning, by George Pearson, M.D. F.R.S., *&c.*

4.—Surgical Lectures, gratuitously, to the Pupils of St. George's Hospital, will be given by Sir Everard Home, Bart.

Proposals and Particulars may be had at No. 9, George-Street, Hanover-Square, and at St. George's Hospital.

Select List of New Publications during the last three Months.

Transactions of Public Societies.

Transactions of the Literary Society of Bombay, with engravings, Vol. II. 4to. 3*l.* 3*s.*

Medical Transactions, published by the College of Physicians in London, with coloured plates, Vol. VIII. 8vo. 12*s.* boards.

Transactions of the Horticultural Society of London, Vol. IV. Part I. 1*l.* 13*s.*

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Chronological and Historical Illustrations of the Ancient Architecture of Great Britain. By Mr. Britton. No. 6.

The Architectural Antiquities of Normandy. By J. S. Cotman. Part II. royal folio. 3*l.* 3*s.*

Views of the Remains of Ancient Buildings in Rome and its Vicinity. With coloured plates. 7*l.* 7*s.*

Picturesque Views of the Architectural Antiquities of Northumberland, from original pictures, painted expressly for the work; by Wm. Dixon and Thos. M. Richardson. Part I. Elephant 4to. 12*s.* Atlas 4to. 18*s.*

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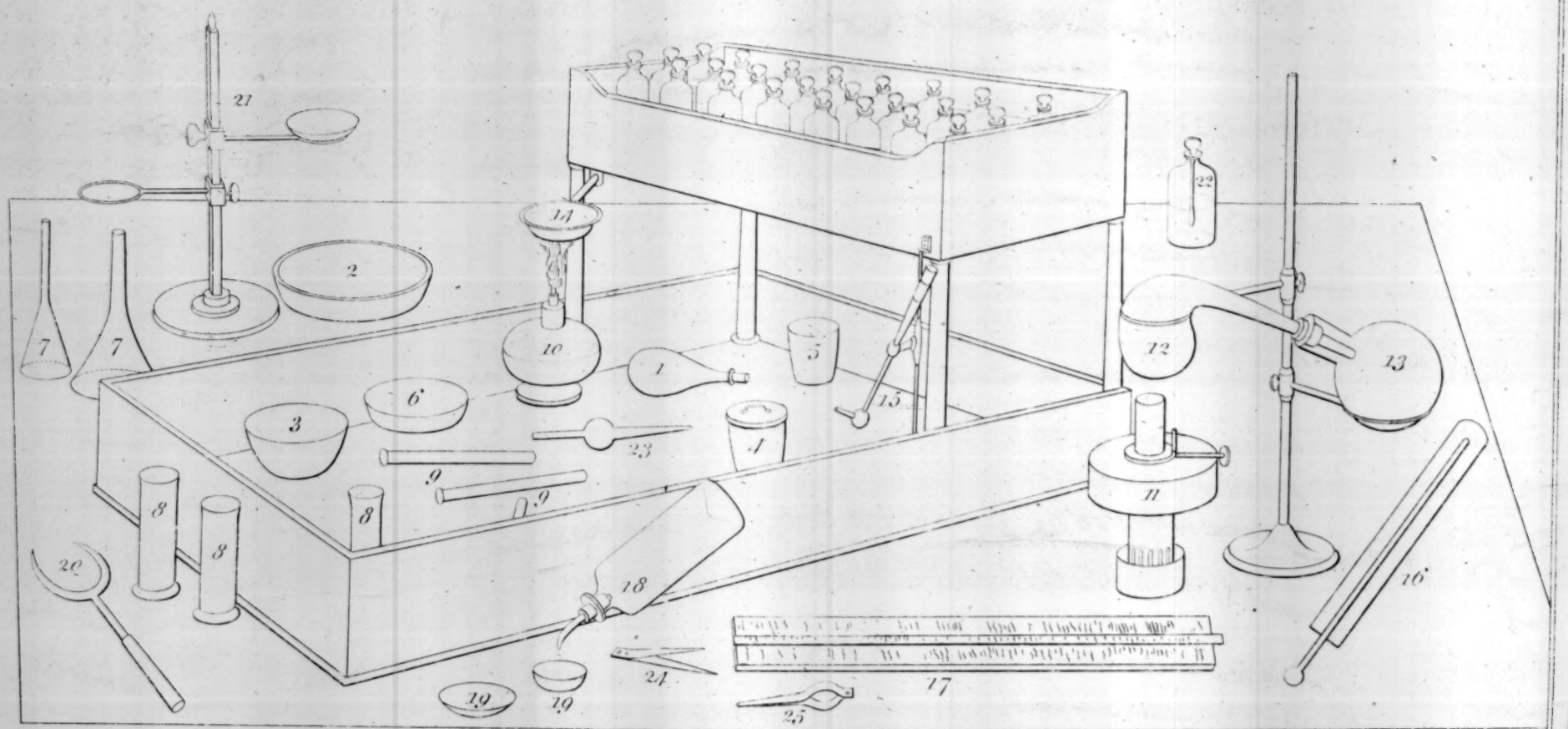

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